the feasibility of expanding the

SWEETPOTATO CANNING INDUSTRY in the SOUTH

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PREFACE

This report examines certain factors which are important in evaluating the economics of expanding the sweetpotato canning industry in Southern States. The report is a contributing project to Southern Regional Marketing Project, SM-8.

Canners and various equipment manufacturing firms contributed valuable information for this research. The following canners deserve special acknowledgment: Martindale Foods, Inc., Williamston, N. C.; Dezauche and Son, Opelousas, La.; Miss America Foods, Lafayette, La.; Princeville Canning Co., St. Francisville, La.; Marydale Canning Co., Oak Grove, La., and Trappey Canning Co., Lafayette, La. Food Machinery and Chemical Corporation, Hoopeston, Ill., and A.K. Robins and Company, Baltimore, Md., provided cost estimates for various equipment items.

Dr. Jerry Law, Louisiana State University, consulted in the plans for study and assisted in obtaining cooperation for the field work in Louisiana; Loyd C. Martin, Marketing Economics Division, Economic Research Service, assisted in the overall planning of the study.

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SUMMARY

In North Carolina and other Southern States, plans are underway to develop a vegetable processing industry to complement the existing fresh market outlet. This study provides information useful in evaluating prospects for economic survival of processing plants in the South. Specifically, the profitability of sweetpotato canning plants was examined under a variety of conditions which may confront a new plant. The profitability of a canning operation depends on a number of variables among which the following are important: Size of plant, length of operating season, percentage of trim and peel loss, price of inputs, and price of finished product.

An economic-engineering approach was used to estimate cost of canning sweetpotatoes in four model plants with capacities of 10,000, 20,000, 30,000, 40,000 pounds of raw product per hour of operation. Existing plants were surveyed in North Carolina and Louisiana, and a synthesis of techniques, practices, and labor utilization was made. From this information, costs were developed for the model plants which are attainable with good management and present equipment and methods. These plants are of a type that would be attainable in any of the commercial sweetpotato production areas in the southern States.

A range of 600 to 1,400 hours was used to evaluate the influence of different lengths of operating seasons. Three levels of trim and peel loss, 30, 40, and 50 percent, were included in the analysis. Current prices of inputs and finished product were first used; then the sensitivity of the analysis to other price levels was examined.

The residual revenue after deducting annual operating expense (excluding interest and depreciation) was discounted over a 15-year planning horizon to estimate the capital value of each plant. Capital value was examined in relation to the initial investment cost of the durable goods in each plant. If capital value exceeded initial investment cost, the plant was considered as having a positive investment value and would be, under the conditions specified in the particular case, a profitable investment.

All four plants were profitable within the 15-year horizon when a 30-percent trim and peel loss was attained, even if operated relatively short seasons each year. With a 50-percent trim and peel loss only the plants with capacities of 30,000 and 40,000 pounds of raw product per hour had a positive investment value within the 15-year horizon and this only if operated a 1,400-hour season each year. All four plants had positive investment values with a 40-percent trim and peel loss with the exception of the 10,000 pound per hour plant when operated a 600-hour season.

A short annual operating season results in a longer number of years before the investment value of a plant becomes positive. For example, the 20,000 pound per hour plant has a positive value within 9 years when operated 600 hours annually as opposed to 3 years when a 1,400-hour season is attainable.

Finished product prices very much below current prices result in considerable pressure on the profitability of each plant. Likewise an increase in price of inputs leads to diminished profitability.

The study leads to the conclusion that new canning plants must be larger than is commonly believed necessary, must be able to operate for longer lengths of season than existing plants in North Carolina are operating, and attain a lower level of loss in the trim and peel operations to survive. In fact, the study points to an opportunity for assisting existing plants to operate under conditions more favorable to economic success before encouraging construction of new plants. Among alternative possibilities are improvement in the quality of raw product and development of multiple-product operations in existing plants.

THE FEASIBILITY OF EXPANDING THE SWEETPOTATO CANNING INDUSTRY IN THE SOUTH

By

Leigh H. Hammond and Richard A. King 1/

INTRODUCTION

Southern States, considered as a group, can be characterized as being predominately agricultural and as having per capita incomes lower than the Nation in general. In recent years, the social, economic, and political aspects of the low income problem have been the focus of increasing concern by individuals, groups, and both Federal and local governmental agencies.

Many suggestions have been made for improving the income position and level of living in Southern States. One idea is to speed industrial development as a means of providing more opportunity for surplus agricultural labor. Another approach suggests that considerable opportunities exist for resource-use adjustment on specific types of farms which would go far to increase efficiency and returns to a given resource base (10). 2/

Beyond efforts to increase on-farm efficiency and to encourage industrialization, it seems only natural that attention also would be directed toward improving the marketing of agricultural products. This is especially true in certain States -- North Carolina in particular. Fruit and vegetable marketing has been the subject of intensive analysis. Research has provided pertinent information to assist in decisions of when, where, and how to market many commodities on the fresh market (8). 3/ These efforts have been quite apropos since the major proportion of fruit and vegetable crops grown in the South is sold through fresh market outlets. However, the almost exclusive dependence of certain areas of the South on fresh markets has alerted some leaders to the possibilities of establishing processing plants to serve as additional market outlets and thereby improve farm income.

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2/ Underscored numbers in parentheses refer to references listed on page 36.

3/ Droge, J. H. Interregional Competition in Marketing Early Commercial Irish Potatoes. 1958. (Unpublished master's thesis, N. C. State Col., Raleigh.); Farris, D. E. Interregional Competition in Fresh Vegetables. 1958. (Unpublished Ph. D. thesis, N. C. State Col., Raleigh. Microfilm at University Microfilms, Ann Arbor); Nichols, T. E., Jr. North Carolina's Competitive Position in the Marketing of Snap Beans and Cabbage. 1959. (Unpublished master's thesis, N. C. State Col., Raleigh.)

Before governmental or private agencies move too far in encouraging the building of new processing plants throughout Southern States, additional information is needed about conditions under which a plant might become established and be reasonably sure of survival for a period long enough to recover investment in buildings and equipment. A series of abandoned processing plants, idle as a result of hasty action, inadequate information, poor analysis, and poor planning would impede, not aid, the region's economy.

The purpose of this report is to provide information about the sizes and types of plants which would most probably be considered for expanded canning operations in Southern States.

THE PROBLEM

The most enthusiastic prospects for a processing industry in North Carolina center on possibilities for canning sweetpotatoes. Several factors support this. The State is the second largest sweetpotato producer in the Nation with a crop averaging $12.3 million annually for 1949-58. Yet, disposition statistics reveal value of sweetpotato sales as averaging $4.3 million annually, meaning that about 35 percent of total production in North Carolina actually reaches the market.

The opinion prevails generally that a canning industry could and should be established to utilize a large volume of off-size sweetpotatoes which are not suitable for fresh market. 4/ These sweetpotatoes are rejected on account of their size, being either too small or too large. A greater part of the crop may be sold if a processing outlet is available.

It is doubtful that a canning plant would be established to process only off-sized sweetpotatoes since most of the existing plants, particularly in Louisiana, contract for all of the production from a specified acreage. They process on a field-run basis without grading out sizes suitable for fresh markets. Therefore, if a sizable processing industry were to develop in North Carolina or in the South, producers might have to consider the alternative of growing acreage exclusively for canning.

A canning industry can be developed by building new plants, utilizing more fully the capacity of existing plants, or expanding the capacity of existing plants. Regardless of the method selected, expansion should rest on sound prospects for economic survival.

Objectives

This report provides information about the profitability of investments in sweetpotato canning plants in North Carolina. The analysis is believed to be applicable throughout most of the South. The direction which developments in the sweetpotato processing industry should take rests on several strategic considerations which influence investment profitability.

Specifically, the research objectives were:

1. To develop estimates of the initial durable goods investment required for four model sweetpotato canning plants having capacities of 10,000, 20,000,

4/ Fresh market is used here to include both green and cured sweetpotatoes.

30,000, and 40,000 pounds of raw product per hour of operation.

2. To estimate costs and revenues in operating the four plants for different lengths of season.

3. To evaluate the influence of length of operating season, product prices, factor prices, and less-than-capacity operation on the profitability of new investment in this industry.

The General Setting

In general, the decision to establish processing plants can be viewed as a problem of entry. Entry is used here to mean the establishment of an independent legal entity and the building of a new plant which adds to the productive capacity of a specific industry (2). Thus, entry embodies the idea of a new firm organized to compete with firms already established in an industry. This concept appears appropriate since North Carolina has few processing plants, and any appreciable expansion will have to be the result of new plants or increased capacity of existing plants.

The organization and launching of a new business requires a willingness on the part of an individual, a group, or some financial institution to supply financial support to the purchase of such things as buildings and equipment, which contribute to the productive process over a number of years. In addition, funds must also be available for purchase of productive factors which make their entire contribution in a given production period. Prior to pledging such financial support, expected returns should be evaluated in relation to alternative uses for available funds. It is also helpful to understand the range of economic conditions which might face a new business upon entering into competition with established firms.

A new firm processing fruits and vegetables would be creating products quite similar to those already being produced in other regions and would be competing with a well organized processing industry. Therefore, the situation is not that of a new firm which places on the market a new product unlike any currently available. The conditions of entry are closely related to the competitive structure of the specific industry. Economic theory offers several alternative models by which to examine the problem of entry.

Starting with the perfectly competitive economy which is characterized by many buyers and sellers (so the actions of any individual have no perceptible influence on prices); no artificial restrictions on demand, supply, and prices of resources and products; mobility of goods and services and resources; and complete knowledge, entry is said to be easy. Thus, under perfect competition there are no barriers to entry and exit by a firm. This ease of entry and exit implies a firm with no durable equipment to encumber its flexibility.

In another economic model -- monopoly -- industry is dominated by one firm. In fact, under pure monopoly the firm and industry are synonymous, and entry, therefore, is highly restricted or impossible.

The assumptions of perfect competition or pure monopoly serve their purpose in theoretical speculations. However, most strategic problems in business management cannot fit into such a tight mold for analysis and insight. In answer to the need for a framework which more closely approximates conditions faced by business, economists developed the theory of monopolistic or oligopolistic competition which provides a clearer insight into the problem of entry of new firms.

The theory of oligopolistic competition deals with a market structure characterized by a small number of relatively large firms, where each must concern itself with the actions or potential actions of rival firms. Each firm strives to produce a product sufficiently differentiated that consumers will prefer it to the products of other firms on the one hand, and yet, on the other hand, sufficiently similar to permit consumers to substitute it for products from rival firms. Product differentiation may be real or imaginary. Brand name acceptance sought by much advertising is one means of creating product differentiation. The competitive behavior of firms in an oligopolistic market may range from direct to implicit collusion through dominant firm leadership all the way to a life and death competitive struggle in price wars.

Any business organized for the purpose of entry into an industry composed of a limited number of firms should be prepared to meet and overcome numerous barriers in order to survive. These barriers may be internal to the new firm in the form of cost disadvantages or external in the form of actions by established firms.

Established firms view new competition with foreboding, since it usually brings the prospect of a loss in market share resulting in a decline in volume and higher unit costs. The degree of concern hinges on whether market demand is considered essentially static or whether the new firm will be able to reach a new market and thereby allow each existing firm to maintain its currect position with respect to market share and volume of output. In reality, the prospects appear rather dim for reaching a new market or expanding demand appreciably for canned sweetpotatoes.

Many analyses have used the theory of oligopoly as a framework for understanding and predicting the price policies and behavior of existing firms in response to the activities of existing or potential competitors. However, less explicit attention has been given to using the theory to understand problems facing new or prospective firms entering an oligopolistic market structure.

In brief, entry problems faced by new firms can be summarized by outlining three barriers to entry of new competition (2). The magnitude of these barriers should be examined before deciding to locate, or to encourage the development of new plants.

Economies associated with large scale operations provide a major barrier to entry for firms which must, for reasons of financial limitations, lack of knowledge, or uncertainty, begin operations at a scale much below a point where unit costs cease to decline appreciably as output increases. Any new firm which finds it necessary to start operations at a scale less than the minimum size necessary to make a reasonable profit will be in a relatively unfavorable position to compete with established firms operating at or above such a volume.

Another barrier is faced in the form of product differentiation. For example, the established fruit and vegetable processing plants often have a favored position with major retail outlets in that the brand name has an acceptance and is already anchored on the scarce display shelf where the new firm may encounter difficulty gaining a position. Concessions in the form of price reductions may constitute a necessary cost to a new firm in introducing an unknown product.

A third barrier is an absolute cost advantage enjoyed by established firms. These advantages reveal themselves in lower unit costs for established firms. Such cost advantages may result from control of superior techniques or strategic factor supplies by established firms, or the market for investment and operating funds may charge new firms higher interest rates. Experienced management and supervisory personnel are important factors giving existing firms an advantage over new entrants to an industry.

The general setting in which a new plant will operate should be kept in mind in order to place in proper perspective the more specific evaluation of profitability of investment in sweetpotato canning plants presented in this report.

THE ANALYTICAL APPROACH

Any productive process requires resources which can be classified into two groups (1) those making their complete contribution during a single production period, and (2) those contributing something over a number of production periods. In sweetpotato canning operations the first group, referred to as variable or direct inputs, includes such items as labor, raw product, sugar, lye, water, power, cans, cases, and labels. The second group, durable goods, includes various items of equipment, machinery, and buildings.

Durable goods are the major part of the decision to build a new canning plant. These items require large sums of capital for relatively long periods of time. Several years usually are required before investment in durable goods is completely recovered. However, in an investment decision, funds considered necessary for durable goods investment should not detract from the importance of the availability of short-term operating funds.

In arriving at a decision as to the advisability of constructing a new canning plant, a significant question deals with the number of years necessary to recoup the initial investment cost. The planning horizon may not be as long as the technical life of the canning plant. 5/ That is, the investor might specify a willingness to invest only if the venture is profitable within a 10- or 15-year period.

Tests of Profitability

An investor, or potential investor, usually is motivated by a desire to maximize profits. A number of alternative criteria exist for dealing with profit maximization on durable goods investments.

The present value of the future revenue stream (V) can be compared with the present value of the future cost stream (C) generated by the plant, and the difference (V-C) maximized.

Another criterion is to maximize the present value of the future revenue stream divided by the present value of the future cost stream (V/C).

Some investors prefer to use the criterion of maximizing the rate of return on the owner's capital or equity.

5/ Planning horizon, as used here, means the number of years an investor is willing to wait for a business endeavor to pay back the initial investment.

A fourth criterion is to maximize the internal rate of return on total invested capital (both equity and loan capital).

In special maximization problems, the four criteria may lead to divergent results. However, in this study each criterion would lead to the same general conclusion. In empirical analyses, the maximization of V-C has advantages of simplicity, ease of handling, and focuses attention on streams of revenue over the planning horizon, or expected life of the plant rather than on individual production periods (5). Thus, V-C was selected as the criterion for this analysis of sweetpotato canning operations.

The Analytical Model

A host of uncertainties confronts any potential investor. A wise decision usually requires an analysis of the strategic variables which influence profitability. In order to accomplish an orderly examination of the key variables in an investment decision, an analytical model is helpful. The theory of investment, as presented by Lutz and Lutz (5), provides the capitalization approach to durable goods investment analysis and uses the maximization of V-C as the appropriate criterion of investment profitability.

For a given plant size, assumed to be operating at technical capacity during each production period, output is a function of the length of operating season. The specification of output for a given period enables residual revenue for the plant to be computed by subtracting total operating cost (excluding interest and depreciation on the fixed investment) from total revenue.

By estimating a series of residual revenues over the planning horizon or expected life of a plant and discounting at the market rate of interest, an estimated capital value of the plant is obtained.

Profitability of an investment is determined by comparing estimated capital value of a plant with its initial investment cost. The difference between capital value and initial investment cost is referred to as "investment value" of the plant. Investment value may be either positive, zero, or negative. When positive, an investor would consider the particular plant to be profitable. If the capital value and initial cost of a plant are equal, or investment value is zero, the investor would be just as well off to invest his funds in the loan market at the prevailing rate of interest. A negative investment value would indicate an unprofitable operation.

A mathematical formula of the model gives a more precise explanation of the relevant variables in such an analysis.

Let V = the sum of discounted residual revenues, the estimated capital value of the plant.

C_d = initial cost of durable goods,

Q_t = residual revenue in any give period ($t = 1, 2, \ldots, T.$)

q_t = number of finished units produced and sold in period t,

P_t = market price of finished product in period t,

$C_v(q_t)$ = total variable costs in period t,

T = the expected lifetime of plant or the planning horizon,

r = rate of interest in market for long term loans, and

S = expected scrap value of plant at date T.

The formula for residual revenue in a given production period is expressed as

$$(1)\ Q_t = p_t\ q_t - C_v\ q_t.$$

The estimated capital value of the stream of residual revenues from time period 1 to T is obtained by

$$(2a)\ V = \frac{Q_1}{(1 + r)} + \frac{Q_2}{(1 + r)^2} + \ldots + \frac{Q_T + S}{(1 + r)^T}.$$

Formula (2a) can be simplified in writing by expressing in continuous form as

$$(2b)\ V = \int_0^I Q(t)\ e^{-rt}\ dt + Se^{-rt}$$

This model combines the essential variables in an investment analysis to give an estimated capital value (V) of a plant which has a known initial investment cost (C_d). In examining investment profitability, a comparison of V and C_d can lead to three results.

$V - C_d < 0$, where the plant has a negative investment value and it would be unprofitable to incur the cost C_d;

$V - C_d = 0$, where the plant has zero investment value and indifference might exit between loaning funds in the market or investing in the plant; and

$V - C_d < 0$, where the plant has a positive investment value and would be considered a profitable venture.

Thus far the model has been expressed in terms of evaluating profitability of a single plant. The decision must be made at some point regarding which size plant should be constructed. The selection of plant size often must be made from a small number of possible sizes.

A particular plant size may be selected by evaluating first one size and then another under a variety of assumptions about the variables influencing profitability and then choosing the size having greater promise of profit maximization. It must be kept in mind, however, that restrictions on both long-term loans and short-term operating funds may dictate consideration of a plant somewhat smaller than the one potentially offering greatest profits.

Strategic variables for a given plant size are residual revenue (Q_t), planning horizon (T), rate of interest (r), and scrap value (S). To clarify how assumptions about length of operating season, finished product prices, factor prices, and less than capacity operation fit into the analysis, a more detailed examination of residual revenue proves helpful. In general form the formula for residual revenue can be expressed as

(3) $Q_t = f(q_t, P_t, C_{vt})$ where q_t = output in period t,

p = price of finished product in period t, and

C_{vt} = variable costs for period t.

Breaking q_t, p_t, and C_{vt} down further we see

(4) $q_t = f(Z_t\ L_t)$ where Z_t = rate of output in period t, and

L_t = length of operating season in period t;

(5) $p_t = f(q_t)$ if volume influences prices received; and

(6) $C_{vt} = f(Z_t, L_t, p_{vt})$ where p_{vt} = price of variable resources and inputs are dependent on Z_t and L_t.

This further elaboration should clarify how residual revenue is influenced by price trends over the planning horizon and length of operating season within a given year.

Assumptions

Assumptions used in the analysis of sweetpotato canning operations were as follows:

Plant size: Based on input of raw product per hour of operation, four sizes -- 10,000, 20,000, 30,000, and 40,000 pounds per hour -- were evaluated and referred to as plant A, plant B, plant C, and plant D, respectively, in this report.

Length of season: The sweetpotato canning season usually begins in September and ends in December or early January. Therefore, in order to lengthen the number of hours operated, it is often necessary to operate multiple shifts. For this analysis a range of 600 to 1,600 hours operation was used.

Factor prices: Since more than one production period is considered, constant prices were used first, and then the influence of a positive factor price trend was included.

Product prices: The same assumption was made about product prices as that made with respect to factor prices.

Capacity of operation: Full capacity operation was assumed, and, then effects of operating at 75-percent capacity were examined.

Sources of Data

An economic-engineering approach (4) was used to estimate the initial investment cost and total operating expenses for the four model plants.

Visiting existing plants, in addition to consulting equipment companies and food-processing specialists, provided a basis for specifying up-to-date techniques for the model plants. Equipment companies provided installed cost and technical information for the essential equipment and machinery. Building engineers estimated the cost of buildings for each plant.

Variable input data were generated through combined study of existing operations and consultation with engineers, food-processing specialists, and numerous suppliers of variable inputs.

A work sampling study in Louisiana canning plants (7) provided estimates of work standards for each job in the canning operation. These work standards were used to compute labor requirements and cost for each model plant. Concurrently, a record was kept on the quantity of various inputs and outputs. Plant records and interviews with plant managers provided information about general operating expenses, such as general office and plant supplies, telephone, salaries, taxes, insurance, and maintenance.

Factor prices were provided by suppliers of the numerous inputs. Product prices were obtained from various price lists of processed foods.

Following development of the basic input-output information for each model plant, the general investment model served as a basis for examining the profitability of each plant under the range of assumptions listed above.

COST AND REVENUE ESTIMATES

The investment analysis requires accumulation of basic data on costs and revenue generated by canning operations. An outline and description of major operations in the sweetpotato canning plant are essential to a clear understanding and specification of input-output coefficients for estimating costs and revenues for each plant.

The description of major operations is presented in terms of techniques embodied in the four model plants. Since selection of techniques was based on what probably would be included in plants planned for construction in the near future, the model plants do not necessarily duplicate operating techniques in any present plant. However, all techniques included in the four model plants were observed in existing plants.

Figure 1 presents the product flow sequence of operations and gives an indication of the type of equipment used in each operation in the general scheme of a model sweetpotato canning plant.

Description of Operations in Model Plants

Raw product receipt.--The grower usually delivers the sweetpotatoes to a canning plant in 50-pound field crates. The crates are dumped into bulk pallet boxes with a capacity of about 1,350 pounds (27 field crates). A forklift truck transfers the pallet box to temporary storage.

Dumping.--During plant operation a forklift truck removes pallet boxes from temporary storage and places them on a pallet box dump mechanism which inverts

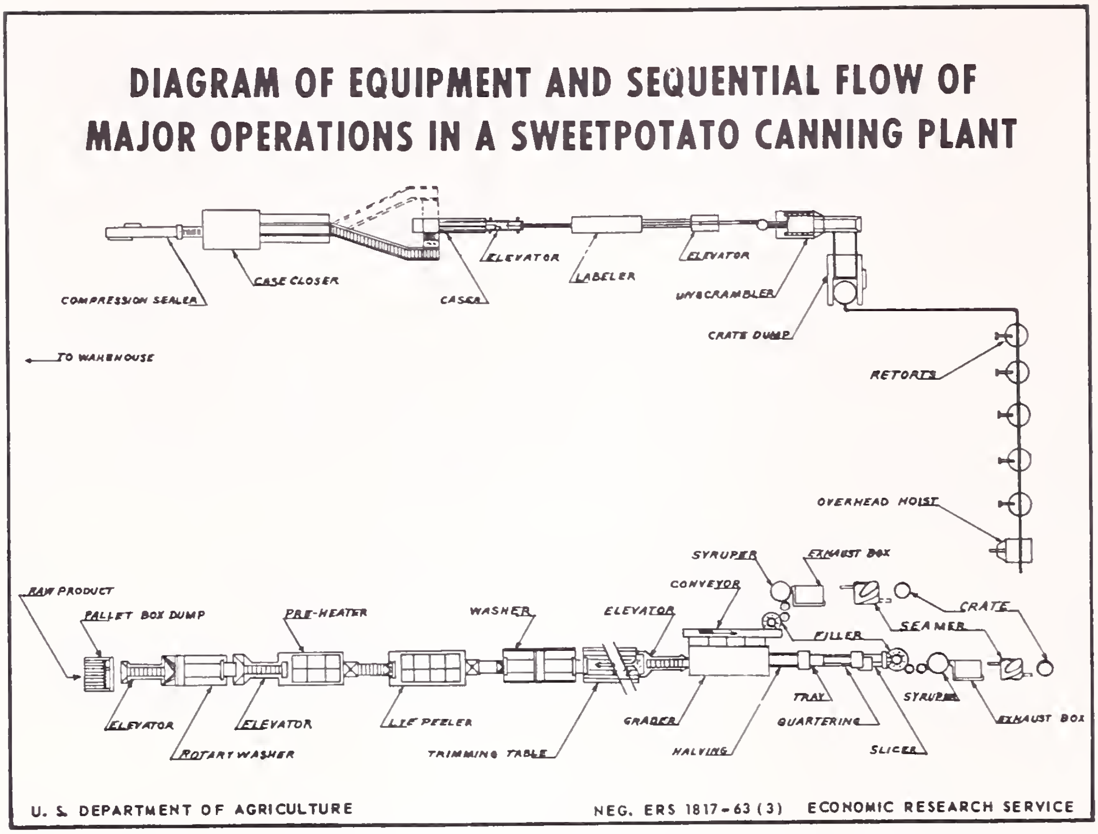

Figure 1

the box, dumping the sweetpotatoes onto an elevator landing which leads to the initial washing.

Washing.--A rotary cage washer removes dirt and other foreign material.

Preheating.--Preheating sweetpotatoes in water at a temperature of 140° to 150° F. for 6 to 10 minutes before peeling reduces action of enzymes near the surface resulting in less discoloration between peeling and closing operations. Preheating also increases the efficiency of the peeling operation.

Peeling.--The sweetpotatoes move through a hot caustic soda solution (lye) which softens the skin.

Washing.--Sweetpotatoes move from the lye peeler into a rotary washer equipped with high pressure water sprays. These sprays, in conjunction with abrasive action of the rotary drum, loosen the skins and wash them away.

Trimming.--Freshly peeled sweetpotatoes move to an open inspection and trim belt where workers pick up each potato and trim away the stringy ends and other undesirable parts. The product suitable for canning is then placed on a belt leading to subsequent operations. Trimming uses a major part of the total labor requirements on the production line.

Sizing.--A rotary drum with various size openings segregates the raw product into three or four size groups.

Slicing.--Large potatoes move through a series of cutting machines which first halve, then quarter the potatoes, and finally slice the quarters into small pieces.

Filling.--The raw product moves onto a circular hand-pack filler with a series of openings around its outer edge through which potatoes are raked into cans passing underneath as the circular top rotates.

Syruping.--Most canned sweetpotatoes are packed in a syrup consisting of sugar and water heated to a point just approaching boiling. The cans move from the filler to an automatic syrup filling machine. Each can moves onto a lifter pad which raises the can to a valve, sealing the lip of the container against the rubber valve and opening the valve, all in one operation. Cans are filled with syrup after which the lifter pad lowers to discharge height and the cans move onto the discharge conveyor.

Exhausting.--After cans are filled with both raw product and syrup, they move through a steam exhaust box to heat the contents to an internal temperature of 160° to 170° F.

Closing.--A sealing machine places a lid on each can and applies pressure to seal the can. An attendant removes the sealed cans from a discharge lip and places them in a retort crate for transfer to cooking retorts.

Retorts.--High pressure steam retorts are used to cook the canned product for varying periods of time, depending on can size, syrup content, and the average temperature of the contents when placed in the retorts. Overhead hoists are used to transfer and lower retort crates into cooking retorts. Upon removal from the retorts, cans are placed in a cooling canal located between the rows of retorts.

Casing.--Retort crates are taken from the cooling canal and moved to a crate dump mechanism which inverts the crate and empties the cans onto an unscrambler which aligns the cans for a labeling machine. If labels are to be applied immediately, the machine applies a label to each can and discharges it into a casing machine which places the appropriate number of cans in each case. The filled case moves through a compression sealer where glue is spread on the top and bottom flaps and pressure seals the case. When the cases are discharged from the case sealer, a laborer stacks them on a pallet for removal to storage by forklift trucks.

Occasionally cans are cased without labels to permit flexibility in selling to buyers who specify that their particular labels must be on the cans. These cans pass through the labeling machine without picking up a label and are cased with the tops and bottoms of the cases interlocked by hand and then stacked on pallets for transfer to storage. When sales and shipments are made, pallets are removed from storage, cases opened, and cans placed on the labeling machine. Then labeling, casing, and case sealing proceed in the manner described above.

Warehousing.--Cased goods are transferred to storage and removed from storage as shipments are scheduled. Since sales and shipments may spread over the entire year, a small warehouse crew is maintained for labeling and shipping.

Initial Investment Cost for the Four Model Plants

The cost of entering the sweetpotato canning business consists of investment in buildings, equipment, and other miscellaneous durable goods.

Buildings.--Space requirements include the canning plant area, storage area, office space, boiler house, and service area. Plant layout is an important determinant of planning plant space requirements, while storage needs are a function of length of season.

Since a plant operates, on the average, only about 4 months, from September through December, while sales spread over a 12-month period, storage space is needed to hold approximately two-thirds of a season's production.

Costs were estimated for steel prefabricated buildings, including 5-inch reinforced concrete floors, plumbing, heating, and electrical wiring (appendix, table 12).

Equipment.--Installed cost of the necessary equipment for each plant was provided by the equipment companies manufacturing commercially the different items (appendix, table 13).

Miscellaneous durable goods.--Necessary durable items other than buildings and equipment include bulk boxes for handling raw product and pallets for handling and storing finished product. Bulk boxes were estimated so that each plant would have sufficient raw product on hand to operate 40 hours. Pallets were estimated on the basis of each plant having a peak inventory of two-thirds of a season's output (appendix, table 14).

Total initial cost of durable goods.--Initial investment cost for each plant is computed in relation to length of operating season (table 1). Storage space and pallet requirements must increase when plans are made for longer operating seasons.

Table 1.--Investment costs of durable goods by specified lengths of season, 4 model sweetpotato canning plants 1/

Length of season	Plant A	Plant B	Plant C	Plant D
	Dollars	Dollars	Dollars	Dollars
600 hours	354,329	495,407	690,588	788,706
800 hours	369,279	525,307	735,439	848,507
1,000 hours	384,229	555,207	780,289	908,307
1,200 hours	399,180	585,109	825,142	968,111
1,400 hours	414,130	615,009	869,992	1,027,911
1,600 hours	429,080	644,909	914,842	1,087,711

1/ Details how storage area and pallet requirements influence investment cost, depending on length of canning season are in appendix, tables 12, 13, 14. Plant A has a capacity of 10,000 pounds of raw product per hour, plant B 20,000, plant C 30,000, and plant D 40,000.

Variable Operating Costs

Since the capacity of a plant is specified in terms of the quantity of raw product dumped per hour of operation, coefficients to show inputs per hour of plant operation are needed for estimating costs.

Input requirements for certain factors are related to the quantity of raw product dumped while others are related to the quantity of product suitable for canning and the distribution of pack between can sizes. Therefore, assumptions about product yield and distribution of pack must be made prior to estimating costs.

Yield of product suitable for canning ranged from 40 to 70 percent (or conversely trim and peel loss ranged from 30 to 60 percent) in plants visited in North Carolina and Louisiana. Trim and peel loss averaged about 42 percent of total pounds dumped. In this report costs were estimated for 30, 40, and 50 percent trim and peel loss.

Most existing plants use a combination of several different can sizes. Variation in size of sweetpotatoes and the disadvantage of a limited range of alternatives to offer buyers are important considerations which encourage the use of more than one can size. Nearly 90 percent of the total U. S. pack of sweetpotatoes is in four can sizes. 6/

Each model plant was assumed to allocate its pack among the four most commonly used can sizes in the same proportions as the total U. S. pack in 1958 and 1959. For computing the allocation percentages, it was necessary to convert the number of cases of each can size packed in the 2-year period to quantity of raw product filled since each can size holds a different quantity. The conversion gave the following distribution of raw product among can sizes:

Size of can	Percentage of raw product
No. 2 1/2	28
No. 303	18
No. 3 squat	37
No. 10	17

Raw product.--The rate of plant operation determines input of raw product. Assuming capacity operation, the four plants require 10,000, 20,000, 30,000, and 40,000 pounds of sweetpotatoes for each hour of operation. Cost of raw product actually canned is a function of price paid to growers and percentage of trim and peel loss. A detailed elaboration on raw product costs is in the appendix.

Direct labor.--Input of direct labor varies with the rate of plant operation, yield of raw product suitable for canning, and allocation of pack among can sizes. A few jobs, however, are machine paced and vary discontinuously with increases in plant capacity.

Six sweetpotato canning plants in Louisiana provided estimates of unit-time requirements for the more important jobs. They were selected to give a range of modern techniques for performing each job. Approximately 60 percent of the total Louisiana pack and 27 percent of the total U. S. pack was canned in these plants.

6/ The Almanac of the Canning, Freezing, Preserving Industry, 1960 ed.

The unit-time requirements from the work sampling study, with a standard allowance of 15 percent for unavoidable delay, were converted to work standards for use in estimating crew requirements for various operating situations (appendix, table 16). 7/ Job and crew requirements were developed for the different assumptions with respect to trim and peel loss (appendix, table 17). Direct labor cost was estimated by applying the appropriate wage rate to the crew requirements.

Sugar.--Syrup mixtures range from 20° to 50° Brix concentration, with the most common concentration 30° Brix. The Brix measure is an indication of the quantity of sugar in 100 pounds of syrup. Thus, a 30° Brix syrup has 30 pounds of sugar and 70 pounds of water per 100 pounds of syrup. Sugar requirements are computed on the basis of output of each can size (appendix, table 15).

Lye.--Two forms of caustic soda -- solid and liquid -- are available for lye-peeling operations. The break-even point between solid and liquid is at a fairly low volume. Therefore, for situations analyzed in this report liquid caustic soda was used. Caustic soda (technically "sodium hydroxide," NaOH) contains, if pure sodium hydroxide, 77.48 percent sodium oxide (Na_2O). The solid form of commercial caustic soda is 96.09 percent pure sodium hydroxide and, therefore, contains 76 percent sodium oxide. The commercial caustic soda is sold in terms of equivalent sodium oxide content, hence "76-percent caustic soda." Liquid caustic is sold on the basis of equivalent units of 76-percent sodium oxide to permit comparisons of liquid and solid. Two concentrations -- 50 and 73 percent -- of liquid are available. The 50-percent liquid is more commonly used in lye peeling of sweetpotatoes since the 73-percent liquid requires special handling and storage.

Input requirements are approximately 27.6 pounds of solid caustic soda per 1,000 pounds of sweetpotatoes dumped (1, 14). No reliable relationship could be established between caustic requirements and percentage of trim and peel loss (14). One gallon of 50-percent liquid caustic is equivalent to 6.5 pounds of solid. Therefore, 4.25 gallons per 1,000 pounds of raw product is the input coefficient for 50-percent caustic soda in sweetpotato peeling.

Cans.--The net weight of potatoes in each size can is the strategic information needed for computing input requirements for cans (appendix, table 18). The net weight enables computing can needs for any assumed yield of product suitable for canning and pack distribution (appendix, table 19). A 5-percent allowance is usually included for bent and damaged cans.

Labels.--Input of labels parallel those of cans except that a 15-percent allowance is made for damaged labels since they are susceptible to a fairly high rate of loss in the labeling machine.

Cases.--Output of different size cans and the number of cans per case determine case requirements (appendix, table 18).

Power.--Electrical power consumption is related directly to the total horsepower necessary to operate the canning line. Engineering estimates suggest that one motor horsepower consumes one kilowatt of electrical power per hour of operation. The motor horsepower is aggregated (appendix, table 13) and a 10-percent allowance added for lighting to estimate total power requirements per hour of operation.

7/ A work standard is defined as the quantity of material or product (specified in appropriate units) a person of average ability can handle each hour of operation.

Water.--Specific operations and machine use of water, such as washing, peeling, and steam generation, determine quantities needed per hour (appendix, table 20). These estimates were provided by equipment manufacturers.

Fuel.--Boilers for generating steam and forklift trucks are the two operations requiring fuel oil. Boilers consume fuel oil at a rate of 1/3 gallon per hour per boiler horsepower. Thus, a 150-rated horsepower boiler requires 50 gallons of fuel oil per hour of operation. Forklift trucks average 1 gallon of fuel per hour.

Variable maintenance.--A portion of machinery and equipment repairs is related to the amount of use per year. The variable repair or maintenance costs for each of the plants in this analysis were computed as 0.5 percent of equipment replacement value (initial investment cost) per 100 hours of operation (6).

Total variable operating costs.--The application of appropriate prices to the input requirments per hour of operation gives estimated variable costs per hour for each model plant. Prices for the variable inputs were obtained from various suppliers of these items and from available published price quotations. These prices are listed in the appendix, table 2 which also include physical input data and costs for each plant. The estimated variable costs per hour of plant operation are shown in table 2.

Table 2.--Estimated variable costs per hour, 4 model sweetpotato canning plants 1/

Trim and peel loss	Variable costs per hour			
	Plant A	Plant B	Plant C	Plant D
	Dollars	Dollars	Dollars	Dollars
30 percent............	861.59	1,681.15	2,514.04	3,334.11
40 percent............	787.97	1,535.89	2,294.44	3,042.54
50 percent............	714.88	1,391.09	2,073.91	2,750.63

1/ Details of the variable input factors in appendix, table 21.

General Costs

In addition to variable costs which are closely related to hourly operation, several items must be considered as annual operating costs to be met regardless of length of season. These general costs include salaries of management, property taxes, interest on short-term credit, insurance, office expenses, warehouse personnel, annual repairs to buildings and equipment, and sales expense.

Accounting records and interviews with managers of existing plants provided the basis for estimating general expenses for the model plants. Some general costs are related to plant size and length of season. Short-term credit costs for operating capital depend on the average investment in inventory for the year.

Salaries.--Employees on an annual basis include a manager, assistant managers, secretarial and payroll personnel, and laborers for warehouse and shipping. Management salary is usually a function of plant size. Table 3 presents estimated personnel requirements and costs for management, office, and miscellaneous plant labor for each plant.

Table 3.--Management and miscellaneous personnel requirements and salaries, 4 model sweetpotato canning plants

Job	Personnel requirements for plant--				Salaries per year for plant--			
	A	B	C	D	A	B	C	D
	No.	No.	No.	No.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
Manager	1	1	1	1	7.0	10.0	15.0	25.0
Assistant manager	2	2	3	3	10.0	16.0	24.0	30.0
Secretarial and payroll	2	3	4	5	4.8	7.2	9.6	12.0
Miscellaneous plant labor	10	15	20	25	21.0	31.5	42.0	52.5
Total	15	21	28	34	42.8	64.7	90.6	119.5

Office expense.--The expense of conducting business, such as telephone, office supplies, and licenses are related in part to volume of business. Information from existing operations indicates that approximately 2 percent of total sales is required for general office expense.

Sales expense.--Some canning plants sell through brokerage firms while others sell through their own salesmen. In either case, sales expense is approximately 6 percent of total sales.

Taxes.--Property taxes must be paid on buildings and equipment. Using North Carolina as a typical Southern State, these tax rates average 1 percent of the initial cost of buildings and equipment.

Insurance.--Fire insurance rates of buildings and contents of canning plants in North Carolina average $1.50 per $100 valuation, or 1.5 percent of initial investment cost of buildings and equipment and average value of inventory.

Interest.--The availability of short-term credit for operating capital is an important consideration in a canning operation. Plant A requires from $715 to $862 for each hour of operation for variable inputs alone (table 2). Since production occurs in the 4-month period from September through December, and sales are spread over a 12-month period, credit needs are computed on the basis of the average amount of operating capital tied up in inventory for the year. Table 4 presents the relationship of short-term interest costs and length of season for the four plants.

Annual repairs.--Costs of annual repairs were estimated to be 1.5 percent of initial cost of building and equipment (6).

Table 4.--Relationship of length of operating season, average monthly inventory, and short-term credit costs, 4 model sweetpotato canning plants 1/

(Assuming 40 percent trim and peel loss)

Length of season	Plant A		Plant B		Plant C		Plant D	
	Average inventory 2/	Interest charges 3/	Average inventory 2/	Interest charges 3/	Average inventory 2/	Interest charges 3/	Average inventory 2/	Interest charges 3/
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
600 hours	157.6	307.2	458.8	608.6	9.5	18.4	27.5	36.5
800 hours	210.1	409.9	611.7	811.5	12.6	24.6	36.7	48.7
1,000 hours	262.4	512.0	781.3	1,014.3	15.7	30.7	46.9	60.9
1,200 hours	315.2	614.4	917.6	1,217.2	18.9	36.9	55.1	73.0
1,400 hours	367.8	716.8	1,070.5	1,420.1	22.1	43.0	64.2	85.2
1,600 hours	420.3	819.2	1,224.3	1,622.9	25.2	49.2	73.5	97.4

1/ Assuming the following distribution of pack: No. 2½ cans - 28 percent, No. 303 - 18 percent, No. 3 squat - 37 percent, and No. 10 - 17 percent.

2/ Hammond, L. H. An Evaluation of the Opportunity for Investment in Sweet Potato Canning Plants in North Carolina. 1961. (Unpublished Ph.D. Dissertation, N. C. State College, Raleigh, N. C.)

3/ Interest rate for short-term credit assumed to be 6-percent per annum.

Total Operating Costs

To estimate total operating costs for different lengths of canning seasons, the variable costs per hour of operation were multiplied by the appropriate number of hours and combined with general costs. General costs were related partly to length of season in that interest for short-term credit, sales costs, insurance, and office expense depend on quantity of output and sales.

Table 5 presents estimated variable costs, components of general costs and total operating costs for plant A, with a range of 600 to 1,600 hour operating season and 40-percent trim and peel loss assumed. This table demonstrates the procedure followed in combining variable and general costs for the other plants with the different assumptions about trim and peel loss.

The estimated total operating cost for each plant under the assumptions about trim and peel loss and length of season is presented in table 6.

An example of less than capacity operation was worked through for each plant (table 7). Each plant was assumed to operate at 75 percent capacity. For example, plant A would dump only 7,500 pounds of raw product per hour of operation compared with 10,000 pounds when operating at capacity. Tables 6 and 7 gives the essential cost data for estimating residual revenue attributable to durable goods investment in each plant.

Revenue

A great deal of the data essential for computing revenue for the different operations were developed with cost estimates, since several inputs were directly related to output of finished product. Physical output information for revenue estimation is included in the appendix, table 22.

Prices of canned sweetpotatoes were obtained from f.o.b. quotations for the Maryland-Virginia area. Shipments from North Carolina has been insufficient to warrent inclusion in published price quotations. However, the Maryland-Virginia data should closely approximate the expected prices for sweetpotatoes canned in North Carolina. Prices received in Maryland and Virginia for canned sweetpotatoes from 1955-60 are listed in the appendix, table 23. These prices, averaged over the 1955-60 period, provide estimates of prices for different can sizes as follows:

Size of can	Average price per case
No. 2-1/2	$4.50
No. 303	2.68
No. 3 squat	4.10
No. 10	4.16

Assuming that the total canned production is allocated between the different can sizes -- 28 percent - No. 2-1/2, 18 percent - No. 303, 37 percent - No. 3 squat, and 17 percent - No. 10 -- the weighted average price used in this analysis is $3.86 per case.

Table 8 includes the total revenue for each plant operating under the different assumptions about length of season and trim and peel loss. The effect of operating at 75 percent capacity is presented in table 9.

Table 5.--Total costs: Value by length of operating season, model sweetpotato canning plant A 1/

(Assuming 40 percent trim and peel loss)

Length of season	Operating costs								
	Variable costs 2/	Salaries 3/	Office expense 4/	Sales expense 5/	Insurance 6/	Taxes 7/	Interest 8/	Annual repairs 9/	Total costs
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
600 hours.........	472.8	42.8	12.0	35.9	8.3	3.5	9.5	5.3	590.1
800 hours.........	630.4	42.8	16.0	47.9	9.5	3.7	12.6	5.5	768.5
1,000 hours.......	788.0	42.8	20.0	59.9	10.8	3.8	15.8	5.8	946.8
1,200 hours.......	945.6	42.8	24.0	71.9	12.0	4.0	18.9	6.0	1,125.1
1,400 hours.......	1,103.2	42.8	28.0	83.9	13.2	4.1	22.1	6.2	1,303.4
1,600 hours.......	1,260.8	42.8	32.0	95.8	14.4	4.3	25.2	6.4	1,481.8

1/ Assuming the following distribution of pack: No. $2\frac{1}{2}$ cans - 28 percent, No. 303 - 18 percent, No. 3 squat - 37 percent, and No. 10 - 17 percent.
2/ $788 per hour (table 2).
3/ From table 3.
4/ 2 percent of total sales.
5/ 6 percent of total sales.
6/ 1.5 percent of total value of buildings and contents.
7/ 1 percent of value of buildings and equipment.
8/ From table 4.
9/ 1.5 percent of value of buildings and equipment.

Table 6.--Operating costs: Relationship between total costs, length of season, and percentage trim and peel loss, 4 model sweetpotato canning plants

Length of season	Operating costs per season when trim and loss is--		
	30 percent	40 percent	50 percent
	1,000 dol.	1,000 dol.	1,000 dol.
		Plant A	
600 hours	643.7	590.1	536.8
800 hours	839.9	768.5	697.4
1,000 hours	1,036 1	946.8	857.9
1,200 hours	1,232.3	1,125.1	1,018.5
1,400 hours	1,428.5	1,303.4	1,179.0
1,600 hours	1,624.6	1,481.8	1,339.6
		Plant B	
600 hours	1,231.7	1,126.4	1,020.4
800 hours	1,615.2	1,775.0	1,333.5
1,000 hours	1,998.8	1,823.4	1,646.7
1,200 hours	2,382.4	2,171.9	1,959.8
1,400 hours	2,766.0	2,520.4	2,273.0
1,600 hours	3,150.0	2,868.8	2,586.0
		Plant C	
600 hours	1,834.4	1,674.9	1,514.4
800 hours	2,408.2	2,195.6	1,981.6
1,000 hours	2,982.1	2,716.3	2,448.8
1,200 hours	3,555.9	3,237.0	2,916.0
1,400 hours	4,129.8	3,757.6	3,383.1
1,600 hours	4,703.6	4,278.3	3,850.3
		Plant D	
600 hours	2,428.3	2,217.0	2,003.8
800 hours	3,189.7	2,908.1	2,623.8
1,000 hours	3,951.2	3,599.1	3,243.8
1,200 hours	4,712.6	4,290.2	3,863.8
1,400 hours	5,474.1	4,931.2	4,483.8
1,600 hours	6,235.5	5,672.2	5,103.8

Table 7.--Operating costs: Relationship between total costs and length of season, 4 model sweetpotato canning plants operating at 75 percent of capacity

(Assuming 40 percent trim and peel loss)

Length of season	Total operating costs per season			
	Plant A	Plant B	Plant C	Plant D
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
600 hours	467.6	880.1	1,306.7	1,722.6
800 hours	605.1	1,146.5	1,704.7	2,248.9
1,000 hours	742.6	1,412.9	2,102.7	2,775.1
1,200 hours	880.1	1,679.3	2,500.6	3,301.4
1,400 hours	1,017.5	1,945.7	2,898.6	3,827.6
1,600 hours	1,155.1	2,212.1	3,296.5	4,353.9

Table 8.--Relationship between total revenue, length of season, and percentage of trim and peel loss, 4 model sweetpotato canning plants 1/

Length of season	Total revenue per season with trim and peel loss--		
	30 percent	40 percent	50 percent
	1,000 dol.	1,000 dol.	1,000 dol.
		Plant A	
600 hours	696.6	599.0	497.4
800 hours	928.8	798.7	663.2
1,000 hours	1,161.0	998.3	829.0
1,200 hours	1,393.2	1,198.0	994.8
1,400 hours	1,625.4	1,397.7	1,160.6
1,600 hours	1,857.6	1,597.3	1,326.4
		Plant B	
600 hours	1,392.6	1,198.2	994.8
800 hours	1,856.8	1,597.6	1,326.4
1,000 hours	2,321.0	1,997.0	1,658.0
1,200 hours	2,785.2	2,396.4	1,989.6
1,400 hours	3,249.4	2,795.8	2,321.2
1,600 hours	3,713.6	3,195.2	2,652.8
		Plant C	
600 hours	2,089.2	1,797.0	1,492.8
800 hours	2,785.6	2,396.0	1,990.4
1,000 hours	3,482.0	2,995.0	2,488.0
1,200 hours	4,178.4	3,594.0	2,985.6
1,400 hours	4,874.8	4,193.0	3,483.2
1,600 hours	5,571.2	4,792.0	3,980.8
		Plant D	
600 hours	2,785.8	2,395.8	1,990.2
800 hours	3,714.4	3,194.4	2,653.6
1,000 hours	4,643.0	3,993.0	3,317.0
1,200 hours	5,571.6	4,791.6	3,980.4
1,400 hours	6,500.2	5,590.2	4,643.8
1,600 hours	7,428.8	6,388.8	5,307.2

1/ Total revenue computed by the following formula: $(\Sigma p_i q_i)H$ where: p_i = price per case for i^{th} can size, q_i = number of cases of i^{th} can size produced per hour, and H = number of hours plant is operated in a given season. Appendix table 13 provides the data for the $\Sigma p_i q_i$ portion of the revenue equation.

The complete data for cost and revenue projections provide the information essential for estimating residual revenue attributable to durable goods investment in each model plant.

Table 9.--Relationship between revenue, pack out and length of operating season, 4 model sweetpotato plants operating at 75 percent capacity

(Assuming 40 percent trim and peel loss)

Length of season	Plant A		Plant B		Plant C		Plant D	
	Total pack	Total revenue	Total pack	Total revenue	Total pack	Total revenue	Total pack	Total revenue
	1,000 cases	1,000 dol.	1,000 cases	1,000 dol.	1,000 cases	1,000 dol.	1,000 cases	1,000 dol.
600 hours..........	115.8	446.4	231.6	892.8	347.4	1,339.2	463.2	1,785.0
800 hours..........	154.4	595.2	308.8	1,190.4	463.2	1,785.6	617.6	2,380.0
1,000 hours........	193.0	744.0	386.0	1,488.0	579.0	2,232.0	772.0	2,975.0
1,200 hours........	231.6	892.8	463.2	1,785.6	694.8	2,678.4	926.4	3,570.0
1,400 hours........	270.2	1,041.6	540.4	2,083.2	810.6	3,124.8	1,080.8	4,165.0
1,600 hours........	308.8	1,190.4	617.6	2,380.8	926.4	3,571.2	1,235.2	4,760.0

PROFITABILITY OF INVESTMENT IN SWEETPOTATO CANNING PLANTS

Revenue and cost discussed in the previous chapter provides the basis for evaluating investment profitability in each plant under various operating situations. The strategic value for evaluating profitability is the investment value of durable goods. Given the expected investment value, a decision may be made about the advisability of entering the sweetpotato canning business.

To estimate the investment value for each plant requires computing residual revenue and estimating capital value of durable goods. Estimated capital value can then be compared with the necessary initial investment for durable goods.

Residual Revenue

Computing residual revenue entails deducting total operating costs (excluding depreciation and interest on fixed investment) from total revenue resulting from the particular operation. The remainder, which is attributed to the operating plant, is referred to residual revenue on the durable goods investment.

Taking the formula given earlier for estimating residual revenue, $Q_t = p_t\ q_t - C_v\ q_t$, and selecting as an example model plant A operated for a 600-hour season with 40 percent trim and peel loss, revenue ($p_t\ q_t$) is estimated as $599,000 while total operating costs as $590,100 (tables 8 and 6). Thus residual revenue in thousand dollars, for a production period of 600 hours would be $Q = 599.0 - 590.1 = 8.9$.

The estimated residual revenues for each plant for different lengths of operating season and levels of trim and peel loss are shown in the appendix, table 24. Residual revenues are also computed for each plant operating at 75-percent capacity and having 40 percent trim and peel loss. There are several negative values for residual revenue, particularly for the 50 percent trim and peel loss situation and for plant A operating at 75-percent capacity. These negative values indicate that revenues do not cover annual operating costs. For these situations it is unnecessary to estimate investment value since a negative value is predetermined by the negative residual revenue.

Estimated Capital Value of Durable Goods

Assumptions about discount rate and planning horizon or expected life of the plant must be specified in order to estimate the capital value of the durable goods in each plant. A discount rate of 6 percent was selected. The planning horizon of a potential investor will likely be within a 15-year period. An investment which becomes profitable only when the discounted income stream extends beyond 15 years will generally be rejected by most suppliers of long-term capital. Therefore, a planning horizon of 15 years was used, even though the useful life of a canning plant may be longer.

Technological improvement is another strong argument for a shortened planning horizon. For example, in a study on the plant operations of marketing pears in California, French (4) has shown that increased efficiencies in the vegetable canning industry in the United States have been such that canning cost per unit of output increased only 31 percent from 1947 to 1959 while prices of canning inputs increased 54 percent during the same period. This is a strong indication that in the future a new plant may be faced with pressures of new technology moving it into a position of cost disadvantage.

In projecting residual revenues over the 15-year planning horizon, it is also necessary to make some assumption about relative prices of both factors and products. It was assumed that relative prices remain constant over the planning horizon. An example will be presented later where the effects of factor and product price trends were studied.

Computational procedure.--The formula used in estimating capital value of durable goods was as follows:

$$V = \frac{Q_1}{(1 + r)} + \frac{Q_2}{(1 + r)^2} + \ldots + \frac{Q_T + S}{(1 + r)^T}.$$

The scrap value (S) was assumed to be zero in this analysis. Such an assumption might, at first, appear to be a drastic departure from reality. However, it is improbable that the decision of whether or not to invest in a plant will be made in terms of expected scrap value at some future date since the primary concern of an investor is when the investment pays itself out. If investment value is negative for the appropriate horizon, the discounted scrap value very likely would be insufficient to alter the final decision.

The assumption about constant prices over the planning horizon means that residual revenue will be equal for each year, or $Q_1 = Q_2 = \ldots = Q_t$. Therefore, the capital value formula can be reduced to $V = Qm$ for computation, where the capitalization multiplier,

$$m = \sum_{t=1}^{T} \frac{1}{(1 + r)^t}.$$

The value of m was computed with r = .06 for values of T from 1 to 15. This value when multipled by an appropriate residual revenue gives the estimated capital value of the plant which generated the revenue for each year in the planning horizon. These values for a 6-percent discount rate are as follows:

Planning horizon (T)	Capitalization multiplier (m)
1	0.943
2	1.833
3	2.673
4	3.465
5	4.212
6	4.917
7	5.582
8	6.209
9	6.801
10	7.359
11	7.886
12	8.383
13	8.852
14	9.294
15	9.711

For example, plant A operating for 600 hours per year with a 40-percent trim and peel loss and a residual revenue estimated at $8,900 has an estimated capital value (V) for a 15-year planning horizon of 8.9 x 9.711, or approximately $86,000.

Operating situations.--Three lengths of operating season were used for estimating capital value of each plant with the three assumptions about trim and peel loss. In addition, each plant was assumed to operate at 75-percent capacity and 40-percent trim and peel loss to reveal the effects of less-than-capacity operation on profitability.

The 600-, 1,000-, and 1,400-hour seasons were selected since these were typical of conditions observed in existing plants. There are about 15 weeks in the September through December canning season for sweetpotatoes. In order to operate 600 hours, one shift working 40 hours per week is necessary. For a 1,000-hour season, one shift working 40 hours per week for 15 weeks plus a second shift for 10 weeks is required. This second shift usually is added during October and November. The 1,400-hour season can be obtained by operating two 45-hour per week shifts over approximately 15 weeks.

Investment Value of Canning Plants

Investment profitability was evaluated by a comparison ($V - C_d$) of the estimated capital value (V) with total initial durable goods investment cost (C_d) for each plant. Computing $V - C_d$ for each year over the 15-year horizon indicates if and when a positive investment value ($V - C_d > 0$) is attained for a particular plant and an assumed set of operating conditions.

It was suggested earlier that an investment analysis might proceed by evaluating each alternative size of plant and then choosing the size with the greatest potential for maximizing profit. In the analysis of each plant, full capacity operation is assumed, except where clearly specified.

Plant A.--The estimated investment value for model plant A under operating conditions of 30-, 40-, and 50-percent trim and peel loss and three lengths of season -- 600, 1,000, and 1,400 hours is presented in the appendix, table 25. Before proceeding further, the 30-percent trim and peel loss situation should be considered only as a worthy goal and not as something that existing plants attain regularly. In reality, the average is often close to 50 percent (11). Therefore, the 40-percent figure was included as an attainable possibility where care is taken in raw product procurement.

The investment value of plant A is negative over the entire 15 years for a 600-hour season and 40-percent trim and peel loss. However, if length of season increases to 1,000 or 1,400 hours per year, the investment value is positive at 10 and 6 years, respectively (fig. 2).

If the plant experiences 50 percent loss of product in the trimming and peeling operations, then $V - C_d < 0$ is predetermined over the entire horizon due to negative residual revenues: That is, revenue is less than annual operating costs. Even a 1,400-hour season is insufficient to overcome the deficit where such high losses occur in the trim and peel operation.

Thus, the profitability of this plant is tied closely with ability to attain a low trim and peel loss and to operate for a relatively high number of hours each year. If type of raw product and quantity of operating capital are unavailable for attaining such goals, then the profitability of plant A is questionable.

Figure 2 shows the effects of operating plant A at 75-percent capacity. It

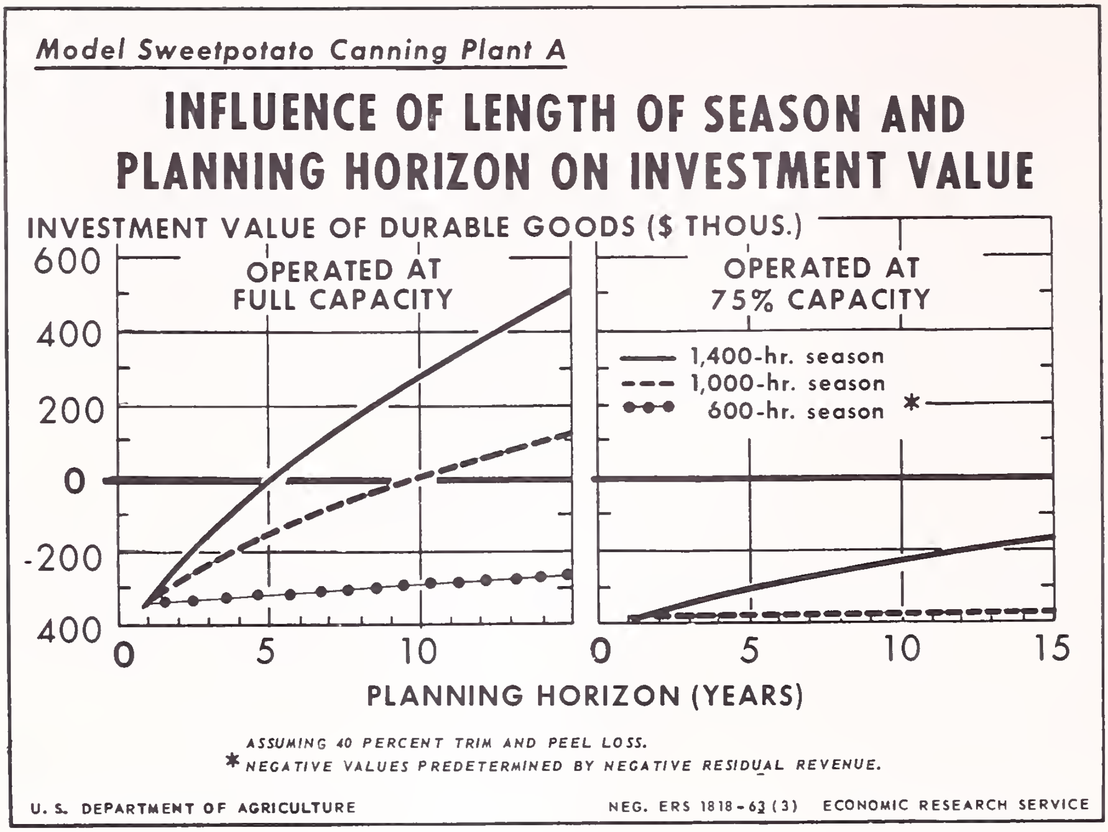

Figure 2

is evident in figure 2 that negative investment values exist regardless of lengths of season the plant operated.

Plant B.--An increase in plant size improves the profit situation for the various operating conditions. Plant B, with a capacity of 20,000 pounds of raw product per hour, has a positive investment value in 9, 4, and 3 years for 600, 1,000, and 1,400 hours, respectively, with 40-percent loss of product (fig. 3).

Positive residual revenues were estimated for the 1,000- and 1,400-hour season where 50-percent trim and peel loss was assumed (appendix, table 25). However, the residual revenue was not sufficient to give a positive investment value to the plant within the 15-year period.

Operating at 75-percent capacity, plant B becomes profitable only when operated for 1,000 hours or more per year (fig. 3).

Plant C.--Plant C shows a positive investment value in a relatively short number of years if the low 30-percent trim and peel loss is achieved. This is also true at the 40-percent level. However, a 50-percent level of loss results in negative values for all except the 1,400-hour season at 13 years of operation (appendix, table 25). Figure 4 presents the 40-percent situation for the three assumed lengths of operating season. This demonstrates again the pressure to achieve longer operating seasons for economic survival.

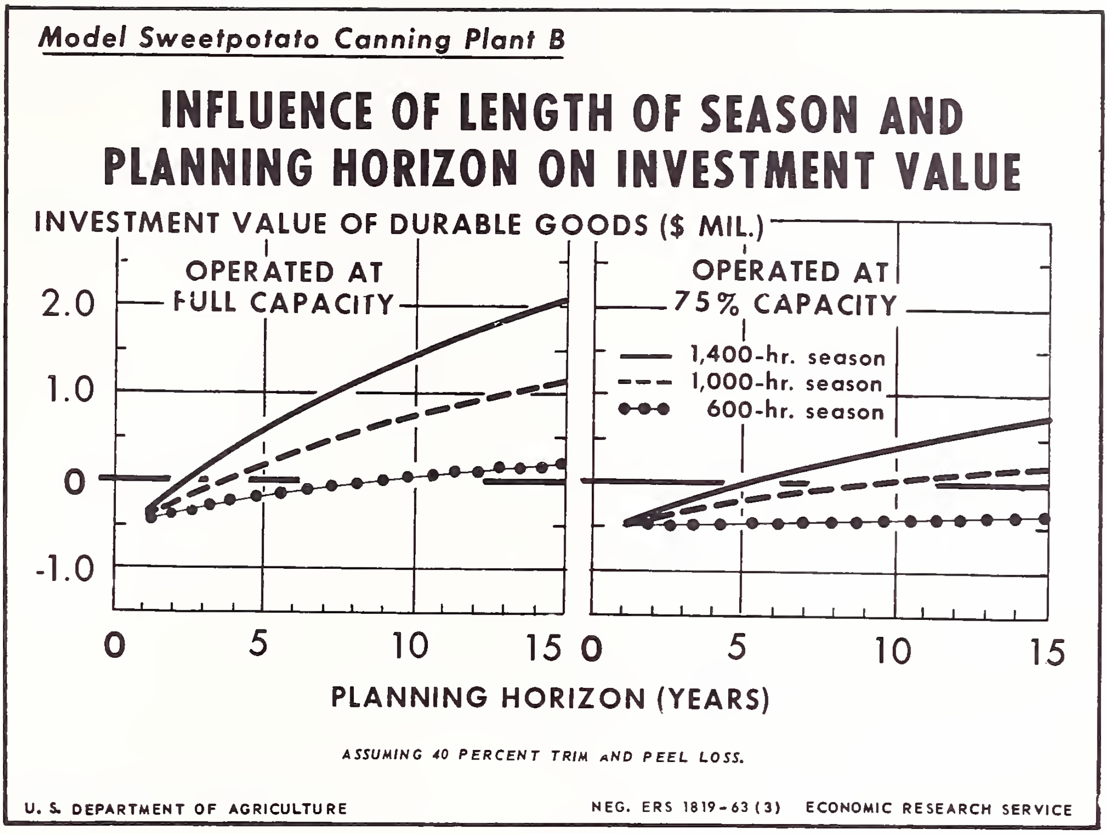

Figure 3

Figure 4 reveals the detrimental influence of operating, for whatever reason, at less than capacity rate. A 600-hour season, which proves fairly profitable under full capacity operation, drops to a negative investment value when operated at 75-percent capacity.

Plant D.--Indications are that a 40,000 pound per hour sweetpotato canning plant can operate profitably under conditions which may be disastrous for smaller plants. However, with 50-percent trim and peel loss investment values are negative for 600- and 1,000-hour seasons and for a 1,400 hour season up to a 9-year horizon. Thus, profitability is rather doubtful for all sizes of plants when trim and peel loss runs as high as 50 percent. This frequently happens in existing operations.

Figure 5 indicates that the investment value of a plant is high with a 40-percent trim and peel loss and length of season 600 hours or more per year. Operating at less than capacity places considerable strain on the profitability under certain conditions and reduces investment value of the plant (fig. 5).

A comparison of four plants.--Relative profitability of the four plants for a given length of season are compared in figures 2-5. Investment value is an increasing function of size of canning plant and length of season. Both rate of output and number of hours operated work together to give a higher annual volume. Since general costs do not increase proportionally, this results in higher residual revenues. Economies to scale also contribute to larger residual revenues and hence greater investment values for larger plants.

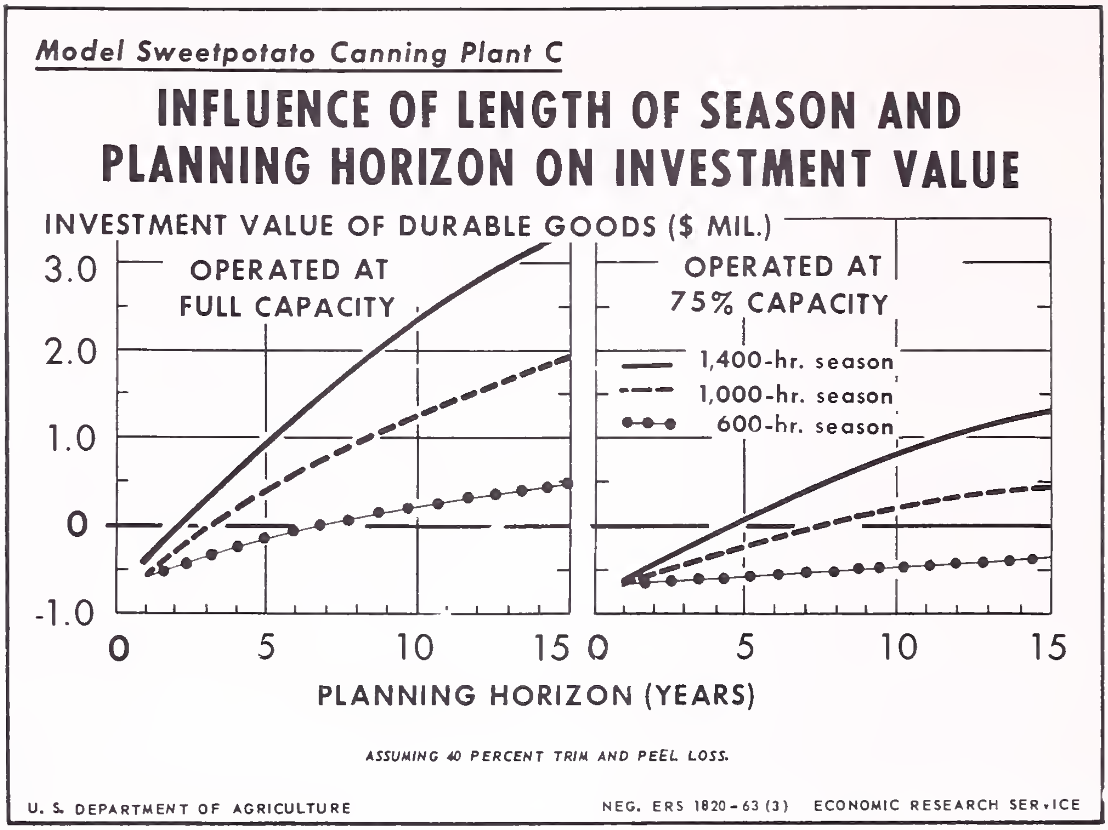

Figure 4

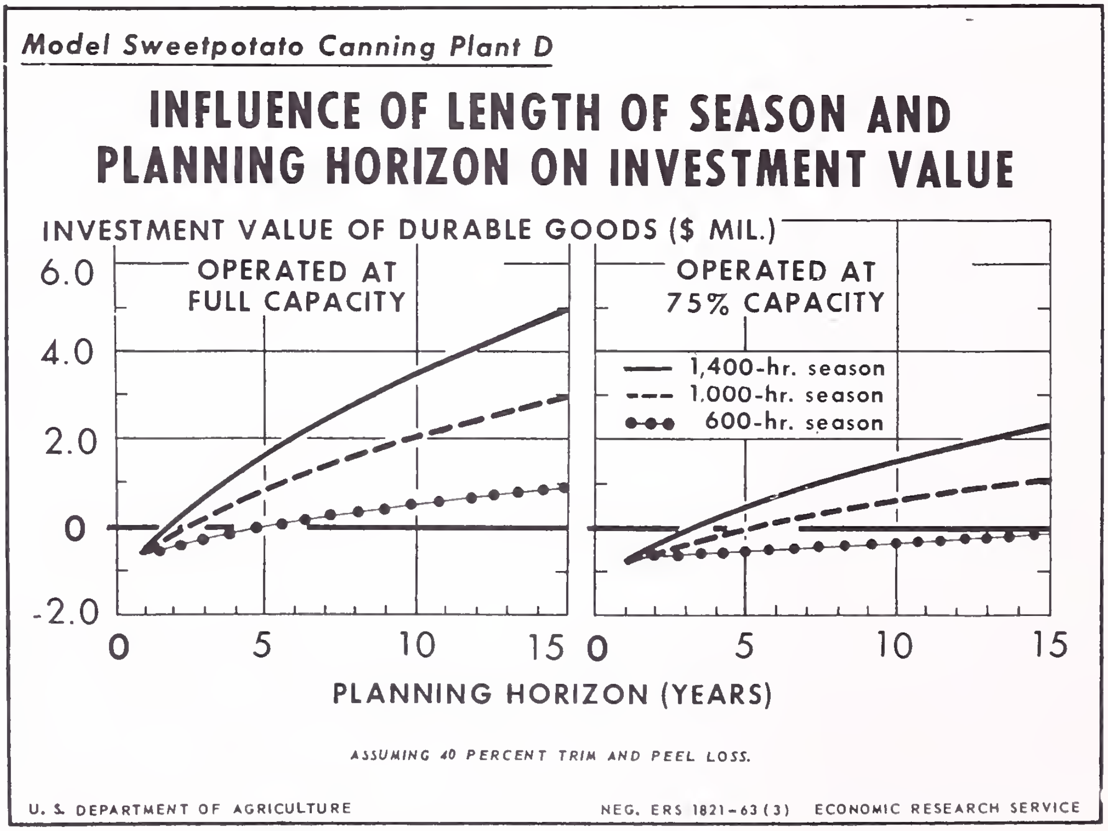

Figure 5

A brief discussion of alternative criteria for evaluating investment profitability was presented earlier. It was suggested that, in a feasibility analysis, alternative criteria would lead to essentially the same conclusion as the $V - C_d$ criterion.

The ratio of capital value to initial investment cost of durable goods (V/C_d) indicates a profitable business when $V/C_d > 1$. The values of the ratio are shown in table 10 for the four plants operating a 1,000-hour season over the 15-year horizon. A comparison of table 10 with the 1,000-hour situation in figures 2-5 reveals the ratio as being greater than one in the same year that $V - C_d > 1$. The ratio also suggests that larger sized plants and longer operating seasons influence profitability.

The internal rate of return is defined as the rate of discount which would result in $V - C_d = 0$, $V/C_d = 1$, or $V = C_d$ and was estimated by setting $V = C_d$, where $V = Qm$, and solving for $m = C_d/Q$. The value of m is the accumulated discount multiplier for the planning horizon. This value was used to enter a table of annuities to find the interest rate which would be used in discounting so that $V = C_d$. For the 600-hour season plant A had essentially no internal rate of return; plant B approximately 10 percent; plant C 15 percent; and plant D 20 percent internal rate of return for a 15-year horizon. These results conform closely to the comparison of $V - C_d$.

Thus, the alternative criteria all point to the larger plants as being more profitable.

Effects of price trends.--Investment value was estimated for each plant, assuming that recent factor and product price trends continue over the planning horizon. Since this assumption likely will not hold true, an estimate was made of the sensitivity of the analysis to different factor and product price trends. The canning cost per unit of output in 1957-59 was 131 percent of the 1947-49 level. This average increase

Table 10.--Ratio of capital value to initial investment cost of durable goods, 4 model sweetpotato canning plants operating 1,000-hour season (assuming 40 percent trim and peel loss)

(V/C_d)

Planning horizon	Plant A	Plant B	Plant C	Plant D
1 year	0.13	0.30	0.34	0.41
2 years	.25	.58	.74	.80
3 years	.37	.85	.96	1.17
4 years	.47	1.10	1.25	1.52
5 years	.58	1.34	1.52	1.85
6 years	.67	1.56	1.77	2.16
7 years	.76	1.77	2.01	2.45
8 years	.85	1.97	2.24	2.73
9 years	.93	2.16	2.45	2.99
10 years	1.01	2.33	2.65	3.23
11 years	1.08	2.50	2.84	3.46
12 years	1.15	2.66	3.02	3.68
13 years	1.21	2.81	3.19	3.89
14 years	1.27	2.95	3.35	4.08
15 years	1.35	3.08	3.50	4.26

The internal rate of return is defined as the rate of discount of 3 percent per year was due to rising costs of inputs used in canning (5). In contrast, wholesale prices for processed vegetables in 1957-59 were only 108 percent of 1947-49 prices, or less than a 1-percent rise annually.

Assuming that both the above factor and product prices continue, linear cost and revenue indices were constructed over the 15-year period for use in adjusting cost and revenue to compute residual revenue for each period. The residual revenues were discounted at 6 percent. Figure 6 presents the investment value for each plant operating a 1,000-hour season and having 40-percent trim and peel loss. Only plants C and D have a positive investment value during part of the 15-year planning horizon. If these two plants continue to operate beyond 7 and 10 years, respectively, the investment value becomes negative. However, it might be possible for the two plants to install certain new cost-reducing technologies during the time that operation was profitable and thus extend the economic life of the plant.

This example of possible price trends which might influence profitability of an investment also demonstrates how the economic life of a durable goods investment may be, and often is, less than the expected technical life. Changing cost and revenue possibilities lend another strong argument supporting potential investors' utilization of short planning horizons rather than relying too heavily on expected conditions which may or may not prevail in the future.

Sensitivity of changes in assumptions.--Many assumptions were necessary in this analysis in order to handle the numerous variables involved. Among the more important assumptions are those dealing with the price of raw product, wage rates, and prices of the finished product. The effects of price trends have been demonstrated.

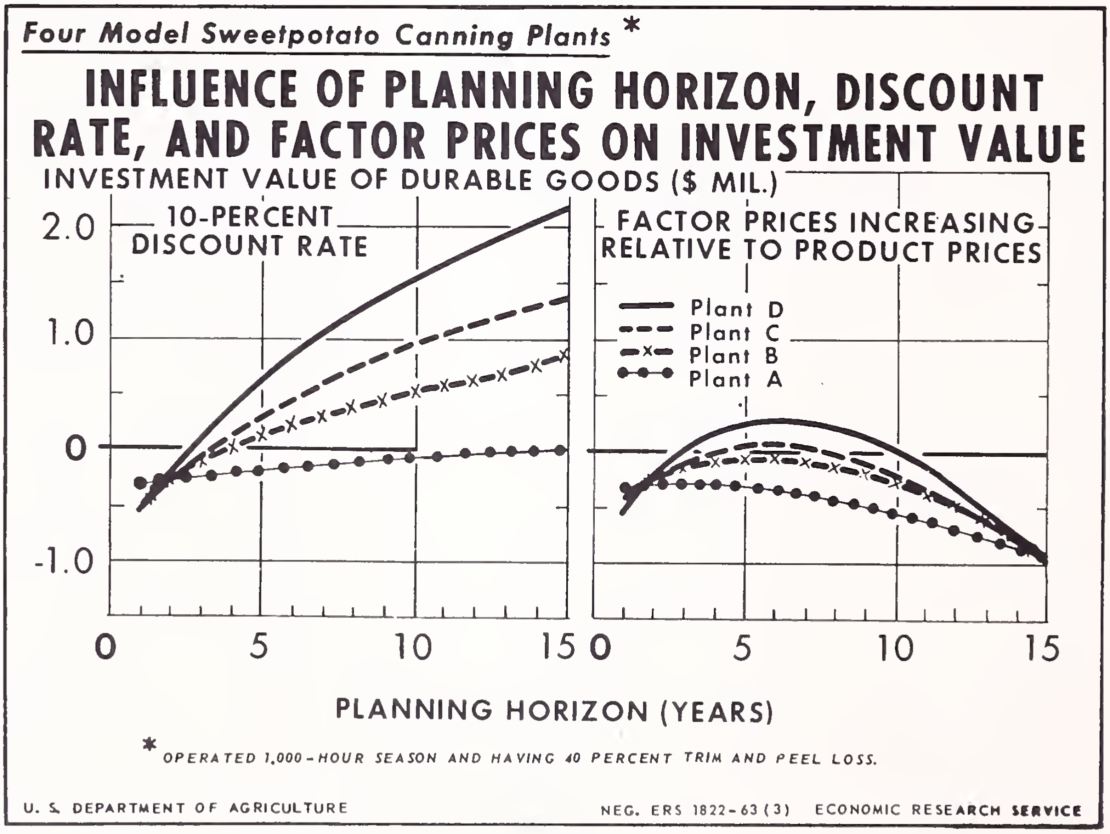

Figure 6

However, it is important to be aware of the sensitivity of the analysis to absolute changes in prices of inputs and products.

A basic wage rate of $1 per hour was used in the analysis. Since some of the jobs had higher rates, the average wage rate used was $1.08 per hour. The implications of a 10-percent increase or decrease in wage rate were examined in conjunction with several levels of price for finished product (table 11).

A weighted average price per case of finished product was computed on the basis of allocation of pack among different can sizes and the price per case of each can size. The price used in this analysis was $3.86 per case. Three other levels of finished product price were evaluated.

The price of raw product was estimated as $2.00 per hundred pounds, typical of the price some processors currently are paying. In addition, farm production budgets indicate that with current yield levels, farmers would receive little return to land and operator's labor when growing sweetpotatoes for sale at this price. Investment value of each plant under different levels of raw product price and finished product price with plants operating 600 hours per season and a planning horizon of 15 years is shown in table 11.

Investment values are negative with a lower finished product price and higher raw product price. Similar results follow with higher wage rates.

In addition to changes in product and factor prices, a particular investor may wish to use a discount rate higher than the prevailing market rate of interest. Figure 6 presents the investment value of the four plants with a 10-percent discount rate. A comparison of figure 6 and figures 2-5, with a 6-percent discount rate, reveals that the smaller plants are more sensitive to the discount rate than the larger plants. Plant A operating 1,000 hours per season has a positive investment value at 10 years with a 6-percent discount rate and at 14 years with a 10-percent discount rate. Plants B, C, and D have positive investment values during the same year regardless of whether a 6- or 10-percent discount rate was used.

This indicates that the four plants would have difficulties if finished product prices were to move much lower than the level used in this analysis, all other variables constant. The same would be true if wage rates and raw product prices were at a higher level. The sensitivity of the analysis to changes in product trends should be kept in mind when considering the problem of entry and the probable influence of new competition on prices.

CONCLUSIONS

The ability of a new plant to compete successfully with existing firms rests on several important considerations. They include availability of investment and operating capital, size of plant, length of operating season, yield of product suitable for canning, availability of a reliable source of raw product, and extent of market barriers in the form of product differentiation.

Four different sized sweetpotato canning plants, A, B, C, and D, with three levels of trim and peel loss -- 30, 40, and 50 percent -- and operating seasons of 600, 1,000, and 1,400 hours were analyzed. These correspond to the range of operating conditions at existing plants in North Carolina and Louisiana in 1961.

Table 11.--Influence of wage rates, raw product prices, and finished product prices on investment value of durable goods, 4 model sweetpotato canning plants

(Assuming a 600-hour canning season, 40-percent trim and peel loss, and a 15-year horizon)

Finished product price per case	Investment value of durable goods with--						
	Wage rate per hour			Price of raw product per 100 pounds			
	$0.97	$1.08	$1.19	$1.60	$1.80	$2.00	$2.20
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
				Plant A			
$3.50	1/	1/	1/	1/	1/	1/	1/
$3.86	-192.1	-262.0	-332.0	- 29.0	-145.5	-262.0	1/
$4.00	27.4	42.6	-112.5	190.5	74.0	- 42.6	-160.1
$4.20	329.4	259.4	189.5	492.5	376.0	259.4	142.9
				Plant B			
$3.50	1/	1/	1/	-390.5	1/	1/	1/
$3.86	326.2	2/215.4	81.4	681.6	448.5	2/215.4	- 17.6
$4.00	763.1	652.4	518.4	1,118.6	885.5	652.4	419.4
$4.20	1,367.2	1,256.5	1,122.5	1,722.6	1,489.5	1,256.5	1,023.4
				Plant C			
$3.50	1/	1/	1/	-390.5	1/	1/	1/
$3.86	672.8	2/515.5	317.4	1,214.7	865.1	2/ 515.5	165.9
$4.00	1,331.2	1,173.9	972.9	1,873.1	1,523.5	1,173.9	824.3
$4.20	2,336.3	2,079.0	1,880.9	2,778.2	2,428.7	2,079.0	1,729.4
				Plant D			
$3.50	1/	1/	1/	-231.3	-697.4	1/	1/
$3.86	1,178.7	2/974.8	718.5	1,907.1	1,440.9	2/974.8	508.7
$4.00	2,058.6	1,854.6	1,598.3	2,786.9	2,320.8	1,854.6	1,388.5
$4.20	3,265.6	3,061.7	2,805.3	3,994.0	3,527.8	3,061.7	2,595.6

1/ Negative values resulting from cost exceeding revenue.
2/ Combination of wage rate and finished price used in major part of the analysis.

If the 30-percent trim and peel loss were attained, all four plants could operate profitably, even for relatively short seasons. However, this low level of product loss was used more as a goal than as a percentage regularly achieved in existing operations.

With a 50-percent loss in the trim and peel operations, only plants C and D (the 30,000 and 40,000 pound per hour plants) prove profitable and then only when operated for 1,400 hours or more per season. Existing plants often experience close to 50-percent loss in trimming and peeling. Therefore, the unprofitability of canning operations under such conditions should spur greater activity by plant breeders, growers, and others who may influence the development of a higher quality sweetpotato for canning.

A 40-percent level of trim and peel loss appears attainable and was considered typical of conditions which might confront a new entrant into the sweetpotato canning industry. Plant A (the 10,000-pound per hour plant) proves profitable under these conditions only when operated 1,000 hours or more per season. The larger plants were estimated to be profitable even when a short planning horizon was assumed. For example, plant D operated 600 hours per season with 40-percent trim and peel loss over a 6-year period produced sufficient revenue over operating costs so that the discounted (at 6 percent) value exceeds initial investment cost by slightly more than $100,000.

In general, the analysis shows that smaller sweetpotato canning plants will operate at a marked disadvantage even if operated for long seasons.

In order for new sweetpotato canning plants to be financially successful, investors should consider the availability of both fixed and operating capital. Occasionally, an enterprising individual will gather pledges for sufficient investment capital to organize a new productive process and fail to assure a source of adequate working capital, only to discover later that the need for working capital often exceed that for fixed investment capital. This is particularly true in fruit and vegetable processing where short-term credit needs frequently are 3 to 5 times the long-term credit requirements. The fixed investment capital requirements ranged from approximately $355,000 for plant A operating 600 hours to approximately $1,028,000 for plant D operating 1,400 hours per season.

Short-term credit ranged from approximately $315,000 for plant A to $2,840,000 for plant D (fig. 7). So even though investment decision making is often cast in terms of fixed investment capital for durable goods, the availability of short-term operating funds may determine the success or failure of a business. If credit is available on a limited basis, plants will have to be operated at a low capacity, that is, for a short season each year.

The decision to build a new sweetpotato canning plant must also consider quantity and quality of raw product which will be supplied. Plant capacity multiplied by number of hours per season gives the quantity of raw product necessary to operate the particular plant. Plant A (the 10,000-pound per hour plant) requires 6 million pounds of sweetpotatoes to operate 600 hours, while plant D (the 40,000-pound plant) requires 56 million pounds to operate a 1,400-hour season.

In North Carolina, for example, the coastal counties (Scot, Hoke, Harnett, Johnson, Nash, Halifax, and Northampton) produced approximately 189 million pounds of sweetpotatoes in 1956, or about 80 percent of the total 238 million pounds produced in the State. Approximately 35 percent of the total sweetpotato production

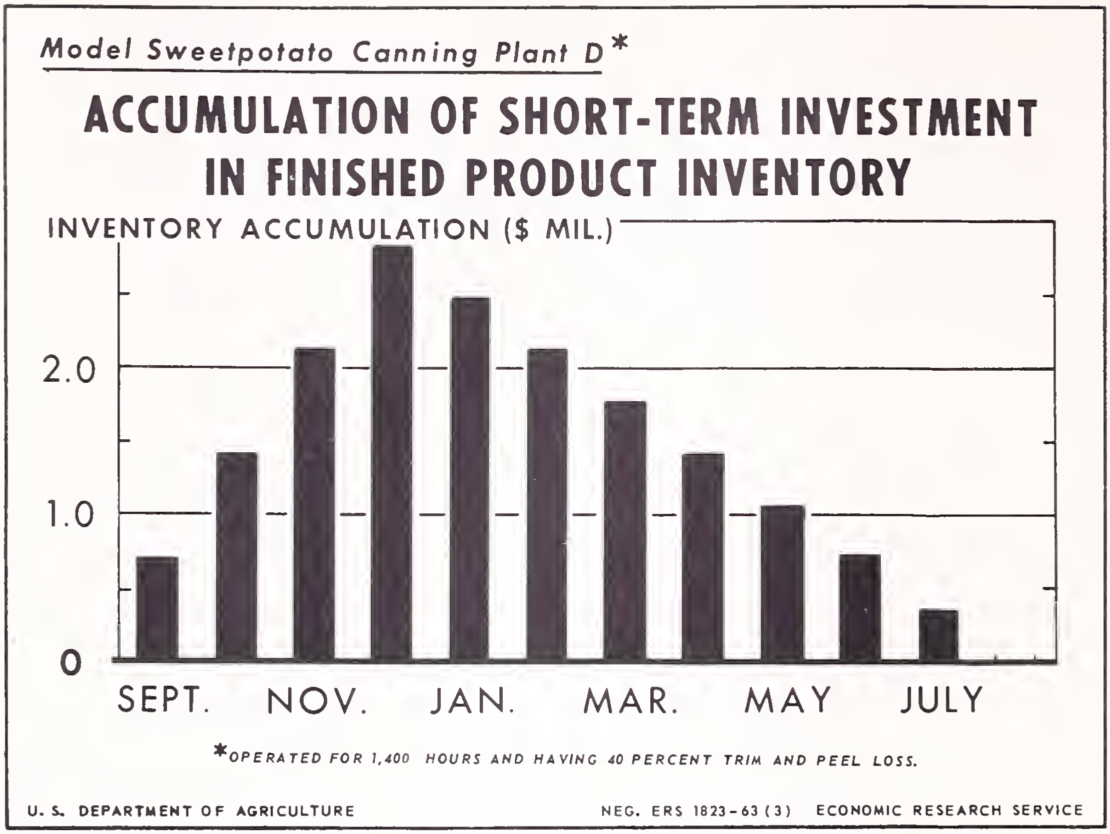

Figure 7

in North Carolina is marketed. Assuming that 50 percent of the remaining production not marketed in the coastal counties could be channeled into canning operations, this volume (61 million pounds) would be sufficient for only one 40,000-pound per hour plant (plant D).

In addition to limited supply of raw products and possible limits on credit, a new sweetpotato plant in North Carolina will likely have to reduce prices for the finished product as a form of entry cost in the market. If price concessions are essential, the point in time when the plant will have a positive investment value is delayed. A 40,000-pound per hour plant operating 1,400 hours would produce approximatley 1,450,000 cases of finished product. To move such a volume into the market a new plant would probably have higher costs than those of established plants. This volume would also represent 23 percent of the total U. S. pack of sweetpotatoes in 1959. Actions of existing plants in face of entry of this size probably would lead to further price cuts. The implications of such price changes were suggested in the analysis of the effects of lower prices on profits. Therefore, the problem of entry is exceedingly complicated when economies to scale and profitability estimates point to the advisability of building the larger plants.

Conjecture as to the degree of success or failure of existing operations also will provide a revealing insight into the advisability of encouraging new plants. Only two of the six plants used in the work sampling study were operated above 1,000 hours per season while two operated in the 400- to 500- hour range. All, except two, were in or near the 10,000 pound per hour category. Five of the plants were in Louisiana, including the two operating more than 1,000 hours where a milder climate permits longer operating seasons without storage of raw product. The trim and peel loss experienced in existing plants was between 40 and 50 percent of total pounds of raw product dumped.

In general, expanding the sweetpotato canning industry in North Carolina is questionable. Capital limitations, raw product requirements, and short lengths of operating seasons in North Carolina will all work to the disadvantage of the kind of canning plant generally believed to be appropriate here. The 10,000-pound per hour plant (plant A) has been generally considered as the size which could be constructed and operated in North Carolina.

Therefore, considerable information is needed that will be helpful in improving present operations before investors plunge into an intensive program to establish new plants. One possible alternative suggested is to convert existing sweetpotato canning plants into multi-product operations which could use the fixed plant over a longer period of the year.

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APPENDIX

Methods

The cost of raw product in sweetpotato canning operations depends on two things -- price paid to growers and trim and peel loss. It might appear that a low price to growers would result in low raw product cost, but the percentage of trim and peel loss may influence costs upwards when stated in terms of product suitable for canning.

The following formula is helpful in computing the effects of both trim and peel loss and price to growers on cost of raw product suitable for canning:

(1) $Y = \frac{X}{(1-P)}$ where Y = cost per hundred pounds suitable for canning,

X = price per hundred pounds paid to growers, and

P = percent trim and peel loss divided by 100.

For example, assume the growers are paid $1.50 per hundred pounds and trim and peel loss is 40 percent, using the formula:

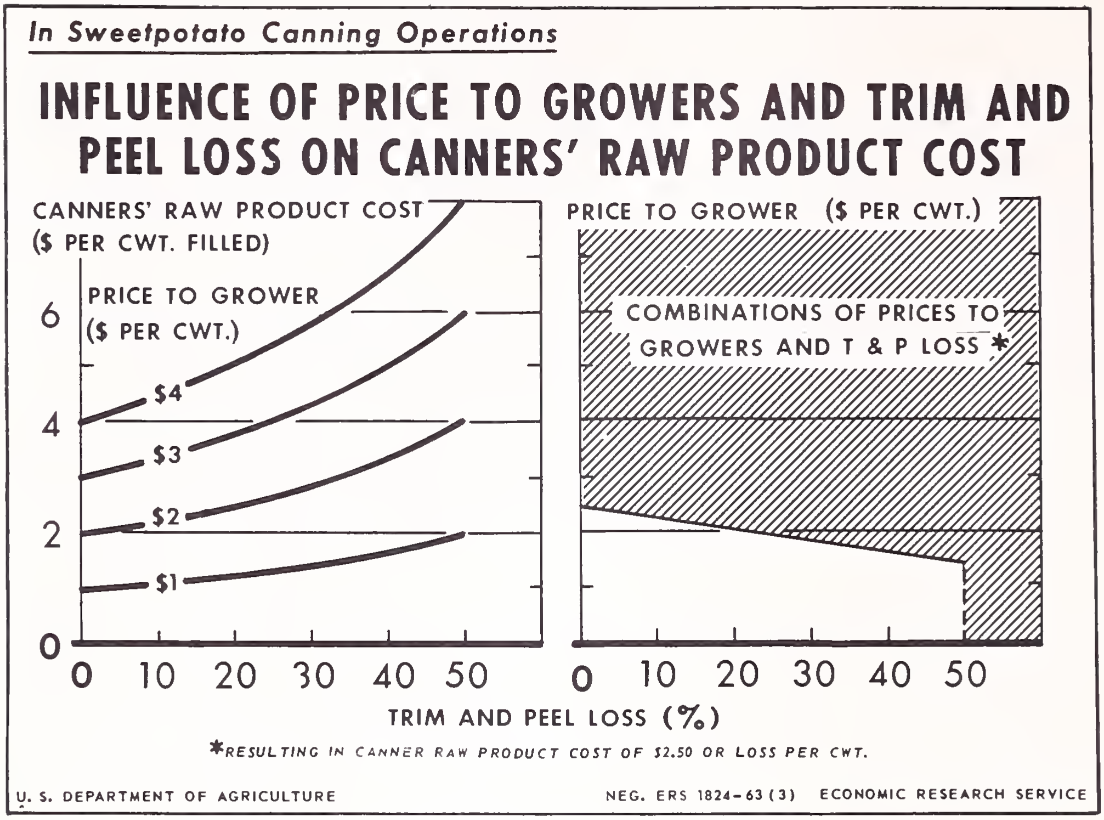
$$Y = \frac{\$1.50}{1 - .40} = \frac{\$1.50}{.60} = \$2.50$$ per hundred pounds of sweet potatoes suitable for canning.

Figure 8 shows the relationship between cost of raw product and several alternative levels of prices to growers and trim and peel loss.

A canner may wish to establish a limit above which cost of raw product suitable for canning should not rise. The specified acceptable level of raw product cost can be obtained from a series of combinations of price to growers and levels of trim and peel loss. The above formula can be manipulated to give (2) $X = (1-P)\ Y$ where X is the price which can be paid growers as a function of allowable raw product cost and trim and peel loss.

It is possible to reward growers of high quality raw product with higher prices and still not exceed final raw product costs of a lower quality and lower price to growers of the raw product.

Figure 8 gives the set of attainable combinations of price to grower and levels of trim and peel loss to give a cost of $2.50 or less per hundred pounds of product suitable for canning. This is graphic evidence that care should be taken in purchasing a high quality raw product.



In Sweetpotato Canning Operations
INFLUENCE OF PRICE TO GROWERS AND TRIM AND PEEL LOSS ON CANNERS' RAW PRODUCT COST
CANNERS' RAW PRODUCT COST ($ PER CWT. FILLED)
PRICE TO GROWER ($ PER CWT.)
$4
$3
$2
$1
0
2
4
6
0 10 20 30 40 50
PRICE TO GROWER ($ PER CWT.)
COMBINATIONS OF PRICES TO GROWERS AND T & P LOSS *
0 10 20 30 40 50
TRIM AND PEEL LOSS (%)
*RESULTING IN CANNER RAW PRODUCT COST OF $2.50 OR LOSS PER CWT.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 1824-63 (3)
ECONOMIC RESEARCH SERVICE

Figure 8

Tables

Table 12.--Space requirements and initial investment cost of building, 4 model sweetpotato canning plants, North Carolina

Plant	Canning plants 1/	Boiler room 2/	Service area 2/	Office space 2/	Storage area by length of operating season (hours) 3/					
					600	800	1,000	1,200	1,400	1,600
	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.	1,000 sq.ft.
	Building space requirements									
A	25.6	0.8	1.2	0.5	15.0	20.0	25.0	30.0	35.0	40.0
B	32.0	.8	1.5	.6	30.0	40.0	50.0	60.0	70.0	80.0
C	33.6	.9	1.8	.8	45.0	60.0	75.0	90.0	105.0	120.0
D	35.2	1.0	2.0	1.0	60.0	80.0	100.0	120.0	140.0	160.0
	Initial investment cost 4/									
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
A	74.2	2.3	3.5	3.5	37.5	50.0	62.5	75.0	87.5	100.0
B	92.8	2.3	4.4	4.1	75.0	100.0	125.0	150.0	175.0	200.0
C	97.4	2.6	5.2	5.5	112.5	150.0	187.5	225.0	262.5	300.0
D	102.1	2.9	5.8	6.9	150.0	200.0	250.0	300.0	350.0	400.0

1/ Estimated from information provided by equipment companies and survey of existing plants.
2/ Estimated from survey of existing plants.
3/ Assumed that two-thirds of season's output will be in storage at peak requirements for space and 15 square feet per 100 cases.
4/ Based on an estimate of $2.90 per square foot for metal prefabricated type building including 5 inches reinforced concrete floor, plumbing, heating and electrical wiring for canning plant, boiler room and service area; $6.90 per square foot of area furnished for office space; and $2.50 per square foot for storage area.

Table 13.--Equipment and installed cost, 4 model sweetpotato canning plants, North Carolina

Equipment	Power (horsepower) for plant--				Equipment for plant--				Equipment cost for plant--1/			
	A	B	C	D	A	B	C	D	A	B	C	D
					Units	Units	Units	Units	Dol.	Dol.	Dol.	Dol.
Pallet box dump	3/4	3/4	3/4	3/4	1	1	1	1	1,995	1,995	1,995	1,995
Elevator	3/4	3/4	1	1	1	1	1	1	800	800	1,000	1,000
Rotary washer	3/4	1	1	1	1	1	1	1	1,525	2,315	2,315	2,315
Elevator	3/4	3/4	1	1	1	1	1	1	800	800	1,000	1,000
Preheater	2 3/4	2 3/4	4	4	1	1	1	1	4,725	5,630	8,500	8,500
Lye peeler	2 3/4	4	8	8	1	1	2	2	5,825	8,700	17,400	17,400
Washer	1	1	2	2	1	1	2	2	2,468	2,468	4,936	4,936
Cross conveyor	---	---	1	1	---	---	1	1	---	---	900	900
Trimming table	1 1/2	2	2	2	1	1	1	1	3,200	4,500	4,800	4,800
Elevator	3/4	3/4	1	1	1	1	1	1	1,000	1,000	1,200	1,200
Cross conveyor	---	3/4	1	1	---	1	1	1	---	800	1,400	1,400
Grader (sizer) and accum. belt	1	3	5	5	1	2	4	4	2,800	7,100	11,500	11,500
Cross conveyor	3/4	3/4	1	1	1	1	1	1	600	850	900	900
Halver	1	1	2	2	1	1	2	2	1,500	1,500	3,000	3,000
Quartering machine	1	1	2	2	1	1	2	2	1,170	1,170	2,340	2,340
O. V. slicer	2	2	4	4	1	1	2	2	3,073	3,073	6,146	6,146
Cross conveyor	---	1 3/4	2 1/2	2 1/2	---	2	3	3	---	2,500	3,400	3,400
Hand-pack fillers	1	2	4	4	2	4	8	8	4,780	9,560	19,120	19,120
Cross conveyor	---	1 1/2	3	3	---	2	4	4	---	1,800	3,600	3,600
Syrupers - 12 valve	4	4	8	8	2	2	4	4	11,464	11,464	22,928	22,928
Exhaust boxes	2	2	3	3	2	2	3	3	7,950	7,950	11,925	11,925
Closing machines:												
2 1/2	2	2	2	2	1	1	1	1	12,170	12,170	12,170	12,170
303	2	2	2	2	1	1	1	1	12,170	12,170	12,170	12,170
3 squat	2	2	4	4	1	1	2	2	14,925	14,925	29,850	29,850
10	2	2	2	2	1	1	1	1	5,205	5,205	5,205	5,205
Retort crates	---	---	---	---	60	120	180	240	1,980	3,960	5,940	7,920
Overhead hoist (includes mono-rail system)	1 1/2	1 1/2	3	3	1	1	2	2	4,244	4,244	8,488	8,488
Retorts	---	---	---	---	10	20	30	40	6,000	12,000	18,000	24,000
Overhead hoist (for retorts)	1 1/2	3	3	4 1/2	1	2	2	3	4,244	7,488	7,988	10,732
Cooling canal	---	---	---	---	1	2	2	2	7,000	12,000	15,000	20,000
Overhead hoist	1 1/2	1 1/2	3	3	1	1	2	2	4,244	4,244	8,488	8,488
Dump and un-scrambler	1 1/2	1 1/2	1 1/2	1 1/2	1	1	1	1	10,000	12,000	16,000	20,000
Labeling machine	1/2	1	1 1/2	2	1	1	2	2	3,070	6,140	9,210	12,280
Casing machine:												
2 1/2	1/2	1/2	1/2	1/2	1	1	1	1	950	950	950	950
303			1/2	1/2			1	1			950	950
3 squat	1/2	1/2	1/2	1/2	1	1	1	1	950	950	950	950
10		1/2	1/2	1/2		1	1	1		950	950	950
Case sealer	1	1	2	2	1	1	2	2	5,000	5,000	8,000	8,000
Boiler	15	25	30	40	2/150	2/250	2/ 300	2/ 400	16,500	27,500	33,000	44,000
Oil storage tank: (10,000 gallons)	---	---	---	---	1	1	2	2	850	850	1,700	1,700
Lye storage tank: (10,000 gallons)	---	---	---	---	1	2	2	3	850	1,700	1,700	2,550
Syrup-mixed (100: gallons)	1	2	3	4	2	4	6	8	1,772	3,544	5,316	7,088
Forklift truck (4,000 lb.-pneumatic)	---	---	---	---	1	1	1	1	6,500	6,500	6,500	6,500
Forklift truck (4,000 lb.-cushioned)	---	---	---	---	3	4	6	6	18,300	24,400	36,600	36,600
Total	57	79 1/2	116 1/4	129 1/4	---	---	---	---	192,599	254,865	375,430	411,846
15 percent additional cost for transportation and installation									28,889	38,230	56,315	61,777
Total installed cost									221,488	293,095	431,745	473,623

1/ Includes cost of power unit. 2/ Boiler horsepower rating.

Table 14.--Requirements and cost of bulk boxes and pallets, by lengths of canning season, 4 model sweetpotato canning plants

Plant	Bulk boxes 1/	Number of pallets by length of operating season (hours) 2/					
		600	800	1,000	1,200	1,400	1,600
	Thous.	Thous.	Thous.	Thous.	Thous.	Thous.	Thous.
A	.3	3.3	4.4	5.5	6.5	7.6	8.7
B	.6	6.5	8.7	10.9	13.1	15.3	17.4
C	.9	9.8	13.1	16.3	19.6	22.9	26.1
D	1.2	13.1	17.4	21.8	26.1	30.5	34.9
	Initial cost						
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
A	4.5	7.4	9.8	12.3	14.7	17.2	19.6
B	9.0	14.7	19.6	24.5	29.4	34.3	39.2
C	13.5	22.1	29.4	36.8	44.1	51.5	58.8
D	18.0	29.4	39.2	49.0	58.8	68.6	78.4

1/ Enough boxes to have 40 hours required raw product on hand and cost estimated at $15 per box.

2/ Requirements computed on basis of peak storage of two-thirds of total season output and number of cases per pallet for different can sizes as follows: No. 2½ - 32, No. 303 - 60, No. 3 squat - 28, and No. 10 - 20. Pallet cost is estimated at $2.25 per 40 X 48-inch reversible pallet.

Table 15.--Relationship between sugar requirements, can size, and Brix concentration of syrup, sweetpotato canning operations

Size of can	Syrup per case 1/	Brix concentration of syrup per case				
		20°	25°	30°	35°	40°
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
No. 2½	15.5	3.1	3.9	4.7	5.4	6.2
No. 303	8.8	1.8	2.2	2.6	3.1	3.5
No. 3 squat	12.0	2.5	3.2	3.8	4.4	5.0
No. 10	14.7	2.9	3.7	4.4	5.2	5.9

1/ Includes 5-percent allowance for spillage and waste. Basic figures on quantity of syrup in each can size were provided by food-processing specialists who have conducted research with different syrup concentrations.

Table 16.--Job description and work standards for direct labor, sweetpotato canning operations

Job description	Unit	Work standard (units per hour)
Receive raw product	Pounds	20,000
Operate dump	do.	40,000
Tend lye tank	do.	40,000
Wash and peel attendant	do.	40,000
Trim:		
30-percent trim and peel loss	do.	186
40-percent trim and peel loss	do.	177
50-percent trim and peel loss	do.	167
Slicer attendant	do.	6,350
Fill for can:		
No. 2½	Case	27
No. 303	do.	24
No. 3 squat	do.	25
No. 10	do.	21
Mix syrup	Pounds	10,000
Closing machine for can:		
No. 2½	Case	84
No. 303	do.	96
No. 3 squat	do.	95
No. 10	do.	100
Empty can supply:		
No. 2½	do.	107
No. 303	do.	110
No. 3 squat	do.	110
No. 10	do.	102
Closing to retort	Retort crate 1/	50
Retort operator	do. 1/	7
Away from retort	do. 1/	50
Crate dump	do. 1/	139
Label machine	Case	542
Form cases	do.	239
Casing:		
No. 2½	do.	246
No. 303	do.	356
No. 3 squat	do.	154
No. 10	do.	136
Stack cases	do.	360

1/ One retort crate holds 10 cases of No. 2½ cans; 18 cases No. 303; 10 cases No. 10; and 12.5 cases of No. 3 squat.

Table 17.--Labor requirements as related to percentage of trim and peel loss, 4 model sweetpotato canning plants 1/

Job	Wage rate per hour	Number of employees in-- 2/											
		Plant A with trim and peel loss (pct)			Plant B with trim and peel loss (pct)			Plant C with trim and peel loss (pct)			Plant D with trim and peel loss (pct)		
		30	40	50	30	40	50	30	40	50	30	40	50
		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Receive raw product	1.73	1	1	1	1	1	1	2	2	2	2	2	2
Operate dump	1.05	1	1	1	1	1	1	1	1	1	1	1	1
Tend lye tank	1.73	1	1	1	1	1	1	1	1	1	1	1	1
Wash and peel attendant	1.05	1	1	1	1	1	1	1	1	1	1	1	1
Trim	1.05	54	57	60	108	114	120	162	171	180	216	228	240
Slicer attendant	1.05	2	2	2	3	3	3	5	5	5	6	6	6
Fill for can size:													
No. 2½	1.05	3	3	2	5	5	4	8	7	6	10	9	8
No. 303	1.05	3	3	3	6	6	6	9	8	9	12	11	12
No. 3 squat	1.05	5	4	4	9	8	8	14	12	12	19	16	16
No. 10	1.05	2	2	2	5	4	4	7	6	6	9	8	8
Mix syrup	1.05	1	1	1	2	2	2	3	3	3	4	4	4
Closing machine:													
No. 2½	1.05	1	1	1	2	2	2	3	3	2	4	3	3
No. 303	1.05	1	1	1	2	2	2	3	2	2	3	3	3
No. 3 squat	1.05	2	2	1	3	3	2	4	4	3	5	5	4
No. 10	1.05	1	1	1	1	1	1	2	2	1	2	2	2
Empty can supply:													
No. 2½	1.05	1	1	1	2	1	1	2	2	2	3	3	2
No. 303	1.05	1	1	1	2	2	1	2	2	2	3	3	2
No. 3 squat	1.05	1	1	1	2	2	2	3	3	3	4	4	4
No. 10	1.05	1	1	1	1	1	1	2	2	1	2	2	2
Closing to retort	1.05	1	1	1	1	1	1	2	2	1	2	2	1
Retort operator	1.26	4	3	3	7	6	6	11	9	8	14	12	11
Away from retort	1.05	1	1	1	1	1	1	2	2	1	2	2	1
Crate dump	1.05	1	1	1	1	1	1	1	1	1	1	1	1
Label machine	1.05	1	1	1	2	1	1	2	2	2	3	2	2
Form case	1.05	2	2	1	3	3	2	4	4	3	5	5	4
Casing:													
No. 2½ No. 303	1.05 1.05	1	1	1	1	1	1	2	2	2	2	2	2
No. 3 squat No. 10	1.05 1.05	2	1	1	2	2	2	4	3	3	5	4	3
Stack cases	1.05	1	1	1	2	2	2	3	3	2	4	4	3
Forklift driver:													
Raw product receipt	1.05	1	1	1	1	1	1	1	1	1	1	1	1
Dump	1.05				1	1	1	1	1	1	1	1	1
Cannery to warehouse	1.05	1	1	1	1	1	1	2	2	2	2	2	2
Warehouse	1.05	2	2	2	2	2	2	3	3	3	3	3	3
Boiler attendant	1.30	1	1	1	1	1	1	1	1	1	1	1	1
Clean-up	1.05	3	3	3	4	4	4	5	5	5	6	6	6
Supervisor:													
Trim	1.58	1	1	1	1	1	1	1	1	1	1	1	1
Closing	1.58	1	1	1	1	1	1	1	1	1	1	1	1
Total employees		107	107	107	189	190	192	278	280	280	361	362	364

1/Assumed distribution of pack out is shown on page 13.
2/Computed on basis of work standards given in table 16.

Table 18.--Cans per case and net weight of sweetpotatoes, by specified size of can 1/

Size of can	Cans per case	Net weight of sweetpotatoes per-- Can	Case	
	Cans	Ounces	Ounces	Pounds
No. 2½	24	19.0	456	28.50
No. 303	24	11.5	276	17.25
No. 3 squat	24	15.0	360	22.50
No. 10	6	72.0	432	27.00

1/ Weight of sweetpotatoes computed on a drained basis.

Table 19.--Relationship of can requirements, percentage trim and peel loss, and can size in sweetpotato canning

Size of can	Cans per 1,000 pounds of sweetpotatoes dumped by trim and peel loss 1/		
	30 percent	40 percent	50 percent
	Cans	Cans	Cans
No. 2½	590	506	420
No. 303	974	835	696
No. 3 squat	746	641	533
No. 10	155	133	111

1/ Does not include 5 percent allowance for damaged cans. Can requirements are computed on the basis of 1,000 pounds for each can size, that is, no distribution between can sizes is assumed.

Table 20.--Total water requirements in sweetpotato canning operations, 4 model sweetpotato canning plants

Plant	Water per hour needed for--			Total
	Production line 1/	Boiler 2/	Syruper 3/	
	Gallons	Gallons	Gallons	Gallons
A	18	0.621	0.687	19.3
B	24	1.035	1.374	26.4
C	42	1.242	2.061	45.3
D	50	2.070	2.748	54.8

1/ Specified by equipment companies.
2/ Specified by boiler company.
3/ Related to quantity of syrup used.

Table 21.--Input data and estimated variable costs, 3 assumed levels of trim and peel loss, 4 model sweetpotato canning plants 1/

Item	Unit	Price per unit	Input quantity per hour: Plant A	Plant B	Plant C	Plant D	Variable cost per hour: Plant A	Plant B	Plant C	Plant D
		Dollars	Units	Units	Units	Units	Dollars	Dollars	Dollars	Dollars
					Assuming 30-percent trim and loss					
Raw product..	Cwt.	2.00	100.000	200.000	300.000	400.000	200.00	400.00	600.00	800.00
Direct labor.	Man-hrs.	2/	107.000	189.000	278.000	362.000	115.86	202.59	299.66	385.34
Sugar (30° Brix syrup..	Cwt.	10.00	11.450	22.900	34.350	45.800	114.50	229.00	343.50	458.00
Lye..........	Gal.	.25	42.500	85.000	127.500	170.000	10.63	21.26	31.89	45.52
Cans: 3/										
No. 2½.....	Thous.	51.00	1.740	3.408	5.112	6.816	88.74	117.48	226.22	354.96
No. 303....	Thous.	33.50	1.840	3.680	5.520	7.360	61.64	123.28	184.92	246.56
No. 3 squat	Thous.	51.00	2.898	5.796	8.694	11.592	147.80	295.60	443.40	591.20
No. 10.....	Thous.	125.22	.277	.554	.831	1.108	34.69	69.38	104.07	138.76
Labels: 4/										
No. 2½.....	Thous.	3.80	1.904	3.808	5.712	7.616	7.24	14.48	21.72	28.96
No. 303....	Thous.	2.80	2.015	4.030	6.045	8.060	5.64	11.28	16.92	22.56
No. 3 squat	Thous.	3.15	3.174	6.348	9.522	12.696	10.00	20.00	30.00	40.00
No. 10.....	Thous.	8.65	.304	.608	.912	1.216	2.63	5.26	7.89	10.52
Cases for cans:										
No. 2½.....	Thous.	113.00	.069	.138	.207	2.760	9.18	18.36	27.54	36.72
No. 303....	Thous.	107.00	.073	.146	.219	.292	7.81	15.62	23.43	31.24
No. 3 squat	Thous.	142.00	.115	.230	.345	.460	16.33	32.66	48.99	65.32
No. 10.....	Thous.	131.00	.044	.088	.132	.176	5.76	11.52	17.28	23.04
Power........	Kwh	.0134	63.000	87.500	128.000	142.250	.84	1.17	1.72	1.91
Water........	Thous.	.150	19.300	26.400	45.300	54.800	2.90	3.96	6.80	8.22
Fuel.........	Gal.	.155	54.000	88.000	107.000	140.000	8.37	13.64	16.59	21.70
Variable repairs 5/..		---	---	---	---	---	11.03	14.61	21.50	23.58
Total variable costs..		---	---	---	---	---	861.59	1,681.15	2,514.04	3,334.11
					Assuming 40-percent trim and loss					
Raw product..	Cwt.	2.00	100.00	200.00	300.00	400.00	200.00	400.00	600.00	800.00
Direct labor.	Man-hrs.	2/	107.00	190.00	280.00	362.00	115.65	203.43	299.24	385.97
Sugar (30° Brix syrup).	Cwt.	10.00	9.81	19.62	29.43	39.24	98.10	196.20	294.30	392.40
Lye..........	Gal.	.25	42.50	85.00	127.50	170.00	10.63	21.26	31.89	45.52
Cans: 3/										
No. 2½.....	Thous.	51.00	1.487	2.974	4.461	5.948	75.48	151.68	227.52	303.36
No. 303....	Thous.	33.50	1.577	3.154	4.731	6.308	52.83	105.66	158.49	211.32
No. 3 squat	Thous.	51.00	2.478	4.956	7.434	9.912	126.84	253.68	380.52	507.36
No. 10.....	Thous.	125.22	.238	.476	.714	.952	29.80	59.60	89.40	119.20
Labels for cans: 4/										
No. 2½.....	Thous.	3.80	1.628	3.256	4.884	6.512	6.19	12.38	18.57	24.76
No. 303....	Thous.	2.80	1.727	3.454	5.181	6.908	4.84	9.68	14.52	19.36
No. 3 squat	Thous.	3.15	2.724	5.448	8.172	10.896	8.58	17.16	25.74	34.32
No. 10.....	Thous.	8.65	.261	.522	.783	1.044	2.26	4.52	6.78	9.04
Cases for cans:										
No. 2½.....	Thous.	133.00	.059	.118	.177	.236	7.85	15.70	23.55	31.40
No. 303....	Thous.	107.00	.063	.126	.189	.252	6.74	13.48	20.22	26.96
No. 3 squat	Thous.	142.00	.099	.198	.297	.396	14.06	28.12	42.18	56.24
No. 10.....	Thous.	131.00	.038	.076	.114	.152	4.98	9.96	14.94	19.92
Power........	Kwh	.0134	63.000	87.500	128.000	142.250	.84	1.17	1.72	1.91
Water........	Thous.	.15	19.3	26.4	45.3	54.8	2.90	3.96	6.80	8.22
Fuel.........	Gal.	.155	54.0	88.0	107.0	140.0	8.37	13.64	16.59	21.70
Variable repairs 5/..		---	---	---	---	---	11.03	14.61	21.50	23.58
Total variable costs.		---	---	---	---	---	787.97	1,535.89	2,294.44	3042.54

See footnotes at end of table

--Continued

Table 21.--Input data and estimated variable costs, 3 assumed levels of trim and peel loss, 4 model sweetpotato canning plants 1/--Continued

Item	Unit	Price per unit	Input quantity per hour				Variable cost per hour			
			Plant A	Plant B	Plant C	Plant D	Plant A	Plant B	Plant C	Plant D
		Dollars	Units	Units	Units	Units	Dollars	Dollars	Dollars	Dollars
			Assuming 50-percent trim and peel loss							
Raw product	Cwt.	2.00	100.000	200.000	300.000	400.000	200.00	400.00	600.00	800.00
Direct labor	Man-hrs.	2/	107.000	192.000	280.000	364.000	115.65	205.53	299.03	387.86
Sugar (30° Brix syrup)	Cwt.	10.00	8.180	16.360	24.540	32.720	81.80	163.60	245.40	327.20
Lye	Gal.	.25	42.500	85.000	127.500	170.000	10.63	21.26	31.89	45.52
Cans: 3/										
No. 2½	Thous.	51.00	1.235	2.470	3.705	4.940	62.98	125.96	188.94	251.92
No. 303	Thous.	33.50	1.310	2.620	3.930	5.240	43.90	87.80	131.70	175.60
No. 3 squat	Thous.	51.00	2.066	4.132	6.198	8.264	105.37	210.74	316.11	421.48
No. 10	Thous.	125.22	.202	.404	.606	.808	25.30	50.60	75.90	101.20
Labels for cans: 4/										
No. 2½	Thous.	3.80	1.352	2.704	4.056	5.408	5.14	10.28	15.42	20.56
No. 303	Thous.	2.80	1.435	2.870	4.305	5.704	4.02	8.04	12.06	16.08
No. 3 squat	Thous.	3.15	2.263	4.526	6.789	9.052	7.13	14.26	21.39	28.52
No. 10	Thous.	8.65	.221	.442	.663	.884	1.91	3.82	5.73	7.64
Cases for cans:										
No. 2½	Thous.	133.00	.049	.098	.147	.196	6.52	13.04	19.56	26.08
No. 303	Thous.	107.00	.052	.104	.156	.208	5.56	11.12	16.68	22.24
No. 3 squat	Thous.	142.00	.082	.164	.246	.328	11.64	23.28	34.92	46.56
No. 10	Thous.	131.00	.032	.064	.096	.128	4.19	8.38	12.57	16.76
Power	Kwh.	.0134	63.000	87.500	128.000	142.250	.84	1.17	1.72	1.91
Water	Thous.	.150	19.300	26.400	45.300	54.800	2.90	3.96	6.80	8.22
Fuel	Gal.	.155	54.000	88.000	107.000	140.000	8.37	13.64	16.59	21.70
Variable repairs 5/		---	---	---	---	---	11.03	14.61	21.50	23.58
Total variable costs		---	---	---	---	---	714.88	1,391.09	2,073.91	2,750.63

1/ Assuming the following distribution of pack: No. 2½ cans--28 percent, No. 303 cans--18 percent, No. 3 squat cans--37 percent, and No. 10 cans--17 percent.
2/ Wage rates vary by jobs, see appendix table 17.
3/ Allows 5 percent for damaged cans.
4/ Allows 15 percent for damaged labels.
5/ Computed as 0.5 percent of replacement value per 100 hours of equipment operation.

Table 22.--Output data, 4 model sweetpotato canning plants operating under 3 assumed levels of trim and peel loss

Size of can	Price per case	Number of cases produced per hour in--											
		Plant A			Plant B			Plant C			Plant D		
		Trim and peel loss--			Trim and peel loss--			Trim and peel loss--			Trim and peel loss--		
		30 percent	40 percent	50 percent	30 percent	40 percent	50 percent	30 percent	40 percent	50 percent	30 percent	40 percent	50 percent
	Dol.	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
No. 2½	4.50	69	59	49	138	118	98	207	177	147	276	236	196
No. 303	2.68	73	63	52	146	126	104	219	189	156	292	252	208
No. 3 squat	4.10	115	99	82	230	198	164	345	297	246	460	396	328
No. 10	4.16	44	38	32	88	76	64	132	114	96	176	152	128
Total	---	301	259	215	602	518	430	903	777	645	1,204	1,036	860

Table 23.--Price per case of canned sweetpotatoes packed in syrup, by size of can, f.o.b. Virginia-Maryland area, 1955-60

Year	Price per case by size of can 1/			
	No. 2½	No. 303	No. 3 squat	No. 10
	Dollars	Dollars	Dollars	Dollars
1955	3.94	2.70	3.54	3.50
1956	4.30	2.82	3.98	3.65
1957	4.58	2.94	4.26	3.72
1958	4.68	2.52	4.50	4.61
1959	5.04	2.58	4.36	4.75
1960	4.50	2.50	3.96	4.75
Total	27.04	16.06	24.60	24.98
Average	4.50	2.68	4.10	4.16

1/ Cans per case as follows: No. 2½ - 24; No. 303 - 24; No. 3 squat - 24; and No. 10 - 6.

Table 24.--Relationship between residual revenue, length of season, and trim and peel loss, 4 model sweetpotato canning plants 1/

Length of season	Residual revenue per year with trim and peel loss of--			
	30 percent 2/	40 percent 2/	50 percent 2/	40 percent 3/
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
		Plant A		
600 hours........	52.9	8.9	-39.4	-21.2
800 hours........	88.9	30.2	-34.2	- 9.9
1,000 hours......	124.9	51.6	-29.0	1.4
1,200 hours......	160.9	72.9	-23.7	12.7
1,400 hours......	196.9	94.2	-18.4	24.1
1,600 hours......	233.0	115.6	-13.1	35.4
		Plant B		
600 hours........	160.9	71.6	-25.6	12.7
800 hours........	243.6	122.4	- 7.1	43.9
1,000 hours......	322.2	172.6	11.3	75.1
1,200 hours......	402.8	224.1	29.8	107.3
1,400 hours......	483.4	275.0	48.3	137.5
1,600 hours......	564.1	325.8	66.8	168.7
		Plant C		
600 hours........	254.8	122.1	-21.6	32.5
800 hours........	377.4	200.4	8.8	80.9
1,000 hours......	499.9	278.6	39.2	129.4
1,200 hours......	622.5	357.1	69.6	177.8
1,400 hours......	745.1	437.3	100.1	226.2
1,600 hours......	867.6	513.6	130.5	274.7
		Plant D		
600 hours........	368.2	179.0	-13.6	62.4
800 hours........	524.7	286.7	29.8	131.1
1,000 hours......	691.8	394.1	73.2	199.9
1,200 hours......	859.0	502.5	116.6	268.6
1,400 hours......	1,026.1	609.3	160.0	339.4
1,600 hours......	1,193.3	717.0	203.5	406.2

1/ Computed by subtracting total cost from total revenue (tables 6-9).
2/ Full capacity.
3/ 75-percent capacity.

Table 25.--Influence of length of canning season and trim and peel loss on the investment value of durable goods, 4 model sweetpotato canning plants 1/

Planning horizon	Investment value of durable goods with trim and peel loss--								
	30 percent			40 percent			50 percent		
	Length of season (hours)			Length of season (hours)			Length of season (hours)		
	600	1,000	1,400	600	1,000	1,400	600	1,000	1,400
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
					Plant A 2/				
1 year	-304	-266	-228	-346	-336	-325	3/	3/	3/
2 years	-257	-155	- 53	-338	-290	-249	3/	3/	3/
3 years	-213	- 50	112	-331	-246	-162	3/	3/	3/
4 years	-171	49	268	-324	-206	- 88	3/	3/	3/
5 years	-131	142	416	317	-167	- 17	3/	3/	3/
6 years	- 94	230	554	-311	-131	49	3/	3/	3/
7 years	- 59	313	685	-305	- 96	112	3/	3/	3/
8 years	- 26	392	809	-299	- 64	171	3/	3/	3/
9 years	6	465	925	-294	- 34	227	3/	3/	3/
10 years	35	535	1,035	-289	- 5	279	3/	3/	3/
11 years	63	601	1,139	-285	22	329	3/	3/	3/
12 years	89	662	1,237	-280	48	376	3/	3/	3/
13 years	114	722	1,329	-276	72	420	3/	3/	3/
14 years	137	777	1,416	-272	95	462	3/	3/	3/
15 years	159	829	1,498	-268	116	501	3/	3/	3/
					Plant B				
1 year	-343	-251	-159	-428	-392	-356	3/	-544	-569
2 years	-200	36	271	-364	-239	-111	3/	-534	-527
3 years	- 65	306	677	-304	- 94	120	3/	-525	-486
4 years	63	561	1,060	-247	43	338	3/	-516	-448
5 years	183	802	1,421	-194	172	543	3/	-507	-412
6 years	296	1,029	1,762	-143	294	737	3/	-499	-378
7 years	403	1,243	2,083	- 96	408	920	3/	-492	-346
8 years	504	1,445	2,387	- 51	517	1,092	3/	-485	-315
9 years	600	1,636	2,674	8	619	1,255	3/	-478	-287
10 years	689	1,816	2,943	32	715	1,408	3/	-471	-260
11 years	774	1,986	3,196	69	806	1,553	3/	-466	-234
12 years	854	2,146	3,437	105	892	1,690	3/	-460	-210
13 years	930	2,297	3,664	138	973	1,819	3/	-455	-188
14 years	1,001	2,439	3,878	170	1,049	1,940	3/	-450	-167
15 years	1,068	2,574	4,080	200	1,121	2,055	3/	-445	-146
					Plant C				
1 year	-451	-309	-167	-575	-518	-458	3/	-743	-776
2 years	-224	136	496	-467	-270	- 68	3/	-708	-687
3 years	- 10	556	1,122	-364	- 36	299	3/	-675	-603
4 years	192	952	1,712	-268	185	645	3/	-644	-523
5 years	382	1,326	2,268	-176	393	972	3/	-615	-449
6 years	562	1,678	2,793	- 90	590	1,280	3/	-587	-378
7 years	731	2,011	3,289	9	775	1,661	3/	-561	-311
8 years	891	2,324	3,756	68	950	1,845	3/	-536	-249
9 years	1,042	2,620	4,197	140	1,115	2,104	3/	-513	-190
10 years	1,184	2,899	4,613	208	1,270	2,348	3/	-491	-134
11 years	1,319	3,163	5,005	272	1,417	2,578	3/	-471	- 81
12 years	1,445	3,411	5,376	333	1,576	2,796	3/	-451	- 31
13 years	1,565	3,645	5,725	390	1,686	3,007	3/	-433	16
14 years	1,677	3,866	6,055	444	1,809	3,194	3/	-415	60
15 years	1,784	4,075	6,365	495	1,926	3,376	3/	-399	120

See footnotes at end of table.

--Continued

Table 25.--Influence of length of canning season and trim and peel loss on the investment value of durable goods, 4 model sweetpotato canning plants 1/ --Continued

Planning horizon	Investment value of durable goods with trim and peel loss--								
	30 percent			40 percent			50 percent		
	Length of season (hours)			Length of season (hours)			Length of season (hours)		
	600	1,000	1,400	600	1,000	1,400	600	1,000	1,400
	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.	1,000 dol.
					Plant D				
1 year	-452	-256	- 60	-620	-537	-453	3/	-839	-877
2 years	-134	360	853	-461	-186	89	3/	-774	-735
3 years	167	941	1,715	-310	145	601	3/	-712	-600
4 years	450	1,489	2,527	-169	457	1,083	3/	-654	-473
5 years	717	2,006	3,294	- 35	752	1,538	3/	-600	-354
6 years	969	2,494	4,017	91	1,029	1,968	3/	-548	-241
7 years	1,207	2,954	4,700	210	1,292	2,373	3/	-499	-155
8 years	1,431	3,388	5,343	323	1,539	2,755	3/	-453	- 34
9 years	1,643	3,797	5,951	429	1,772	3,116	3/	-410	60
10 years	1,842	4,183	6,523	528	1,992	3,456	3/	-369	150
11 years	2,031	4,548	7,064	623	2,200	3,777	3/	-331	234
12 years	2,208	4,892	7,574	712	2,395	4,080	3/	-294	314
13 years	2,376	5,216	8,055	796	2,580	4,366	3/	- 260	389
14 years	2,534	5,522	8,509	875	2,754	4,635	3/	-228	459
15 years	2,683	5,810	8,937	949	2,919	4,889	3/	-197	526

1/ Plant A has a capacity of 10,000 pounds of raw product per hour; plant B 20,000 pounds per hour, plant C 30,000 pounds per hour, plant D 40,000 pounds per hour.
2/ For details, see Hammond (cited in table 4, footnote 2), pp. 129-140.
3/ Negative value predetermined by negative revenue.